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No. 10

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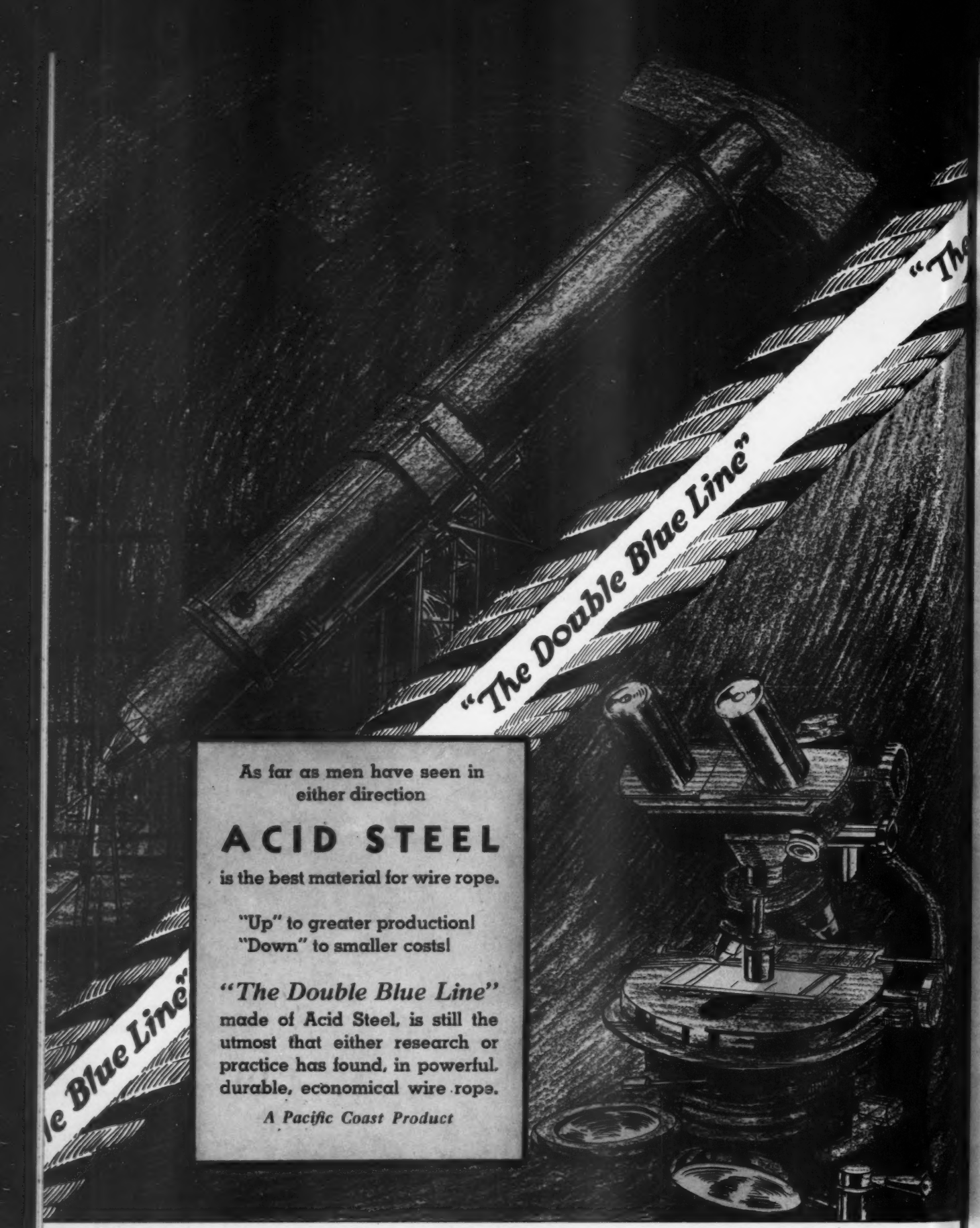

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THE AUTHORITY ON THE CALIFORNIA OIL INDUSTRY

MAY 20, 1938
VOL. 31 » NO. 10
WHOLE NO. 1513

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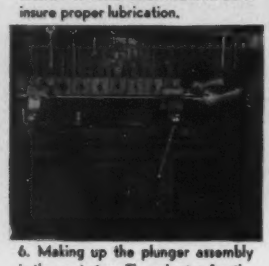
2. The first assembly operation consists of inserting liners into pump jacket. Note that faces of liners are carefully cleaned before inserting.

3. Collars are then loosely screwed into both ends of the pump jacket. Interior of liners is flooded with oil to insure proper lubrication.

4. The mandrel is now inserted through the entire length of the pump jacket, thus bringing the liners into proper alignment.

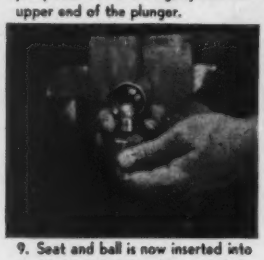
5. While mandrel is still inserted, collars at each end of jacket are tightened. This maintains proper alignment after mandrel is withdrawn.



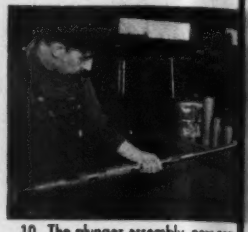
6. Making up the plunger assembly is the next step. The adapter for the pump rod is screwed tightly into the upper end of the plunger.

7. The rod guide is now assembled to the top-lock body. This assembly is then slipped over the pump rod.

8. The pump rod is then tightened into the plunger adapter, and the top-lock body is loosely slipped over the pump rod.

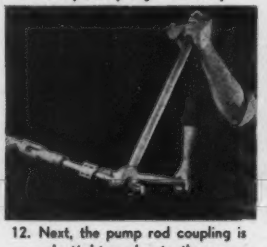


9. Seat and ball is now inserted into the lower end of the plunger and the Perry nut tightened against seat. This completes plunger assembly.



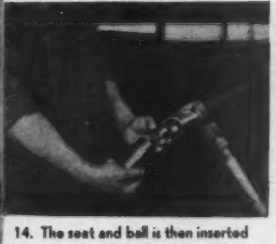
10. The plunger assembly, now complete, is inserted into the pump barrel, which has been properly aligned, as described in No. 4.

11. After inserting the plunger assembly into pump barrel, top-lock body and rod guide are tightened into top collar of pump barrel.

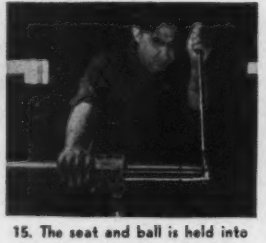


12. Next, the pump rod coupling is securely tightened onto the pump rod. This completes the top end of the pump assembly.

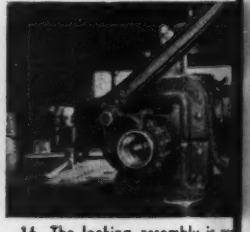
13. It is now necessary to complete the bottom end of the pump. The double valve cage is now screwed into the combined collar and cage.



14. The seat and ball is then inserted into the double valve cage. Seat and ball have been previously vacuum tested for perfect seating.



15. The seat and ball is held into place by the standing valve body. This standing valve body acts as a pilot when lowering pump into well.



16. The locking assembly is now made up and secured by the clamping collar. The pump is now oiled and painted, and boxed for shipment.

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Coalinga District Eocene Production

Consultant Describes Factors Which Influence Area Prospects

By Gerard Henny

The geologic formations referred to in this article are the following:

Tulare (Pleistocene).

Etchegoin (Pliocene). The lower part of the Etchegoin is called Jacalitos. As it is difficult to map a distinct limit between the two formations, he writer calls the entire formation Etchegoin.

McLure Shale (Upper Miocene). A name, given by the writer, for a distinct shale horizon present in the southwest part of the map (in black).

Santa Margarita (Upper Miocene)

Temblor (Middle Miocene). The correct name should be here: Monterey-Temblor.

Eocene. The Upper part of this formation is represented by the Kreyenhagen Shale. The upper member of this shale —not everywhere present—is considered to be of Oligocene age. The lower part of the Eocene consists of sandstones and is considered to be of Domengine age. The oil sand in this formation is called: **Avenal Sand.**

Cretaceous.

Franciscan (Jurassic?).

Description of Formations

The Franciscan is a great thickness of serpentine rocks and metamorphosed sediments.

The Cretaceous lies unconformably upon the Franciscan and below the younger formations. The unconformity between the Cretaceous and the Echegoin is very apparent to the west and southwest of Coalinga. When following the San Lucas Highway from west of the map in the direction of Coalinga, one can observe, along Waltham Creek, a constant northeast dip of about 40 degrees in the Cretaceous. This dip is continuous from Curry Mountain to Alcalde where this formation dips under the Etchegoin. Over this monocline series of Cretaceous, with a thickness of over 10,000 ft., the Etchegoin is folded in an anticline. Apparently this Cretaceous continues to the west in a monoline series under a syncline in the Etchegoin in Waltham Valley, where it lies on the Franciscan cropping out on the southwest flank of the Valley.

The Cretaceous, consisting mostly of shales, is a good source material for oil. Although it does not contain porous sands, which could serve as reservoir rocks for oil, it has undoubtedly contributed much of the oil in the higher formations. The Miocene beds as well as the Eocene beds are, in the Coalinga District, in direct contact with the Cretaceous and could thus have absorbed the oil originally in the Cretaceous Shales.

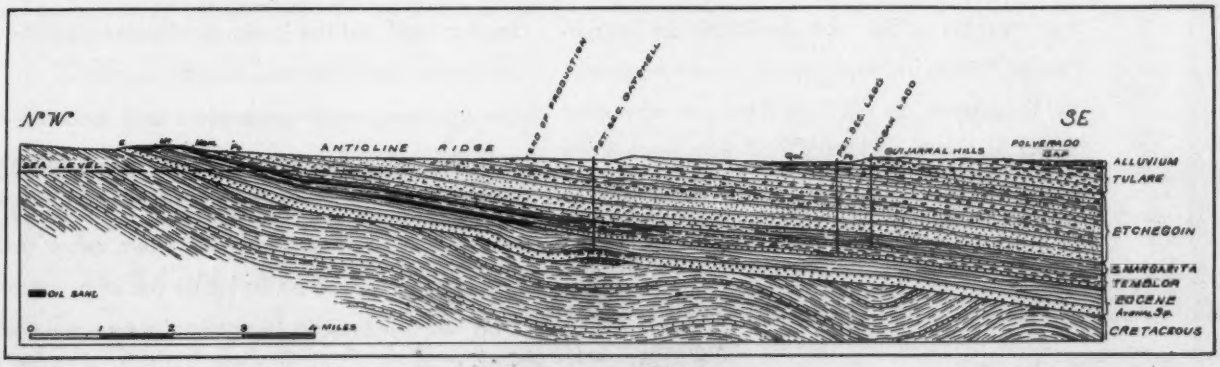
There are some small oil wells in the upper part of the Cretaceous, in the Moreno Shales, in the little Oil City Field at a short distance north of Coalinga.

The Eocene consists of a lower sandstone member, which has a thickness of 300 to 400 ft. in the Coalinga District, and an upper shale member: the Kreyenhagen Shale, which has a thickness of 1000 to 1750 ft. Although it is known that the Kreyenhagen Shale overlaps the Domengine, there is no angular unconformity between the two members in the Coalinga District. Therefore it is not likely that the oil of the Avenal Sand in the Domengine could be trapped anywhere in the Coainga District under an overlap of the Kreyenhagen Shale.

The Temblor however overlaps the entire Eocene series in the northern part of Reef Ridge, as marked on the map near the middle of its south border. On this border of the map there is still some of this Eocene in contact with the Cretaceous, but, at a short distance to the northwest, the Temblor is in its turn directly lying on the Cretaceous, overlapping the Eocene. However, it is perhaps no use looking for oil below this Temblor overlap, the latter formation consisting here mostly of sandstones.

The Monterey-Temblor has a thickness of between 1,000 and 1,200 ft. It lies unconformably below the Santa Margarita and Etchegoin formations, and, as we already know, unconformably above the Eocene. In the East Coalinga Area, the upper part of the Temblor consists of the Big Blue which was originally laid down by a big landslide of serpentine rocks. It is directly below this Big Blue that the first oil is found in the East-Side Coalinga Field. It was called by Arnold and Anderson the B-Zone. The C- and D-Zones are lying directly above the Kreyenhagen Shales and are marked on the cross-section as one oil-zone. The oil in the B-Zone was trapped along the plunging anticline by the irregular surface of the Big Blue, while the oil in the C- and D-Zones was probably trapped off-lapping against the Kreyenhagen Shales (see: Well No. 3 in the cross-section of the April 20, 1938 issue of this magazine). In the West-Side Coalinga Field the oil is trapped in the Temblor by the overlap of the Etchegoin.

The Santa Margarita is represented by sands and conglomerates in the East-Side Coalinga Oil Field. It has a thickness here of about 800 ft. Along Reef



This cross-section is correct as low as the Miocene. The local pitch to the northwest in the Avenal Sand in the vicinity of Gatchell Well is conjectural. The pitch in the Cretaceous at the northwest end of the cross-section is correct, however the folds in this Cretaceous are also conjectural. The writer tries to portray here merely the great unconformity existing between the Cretaceous and the overlying formations.

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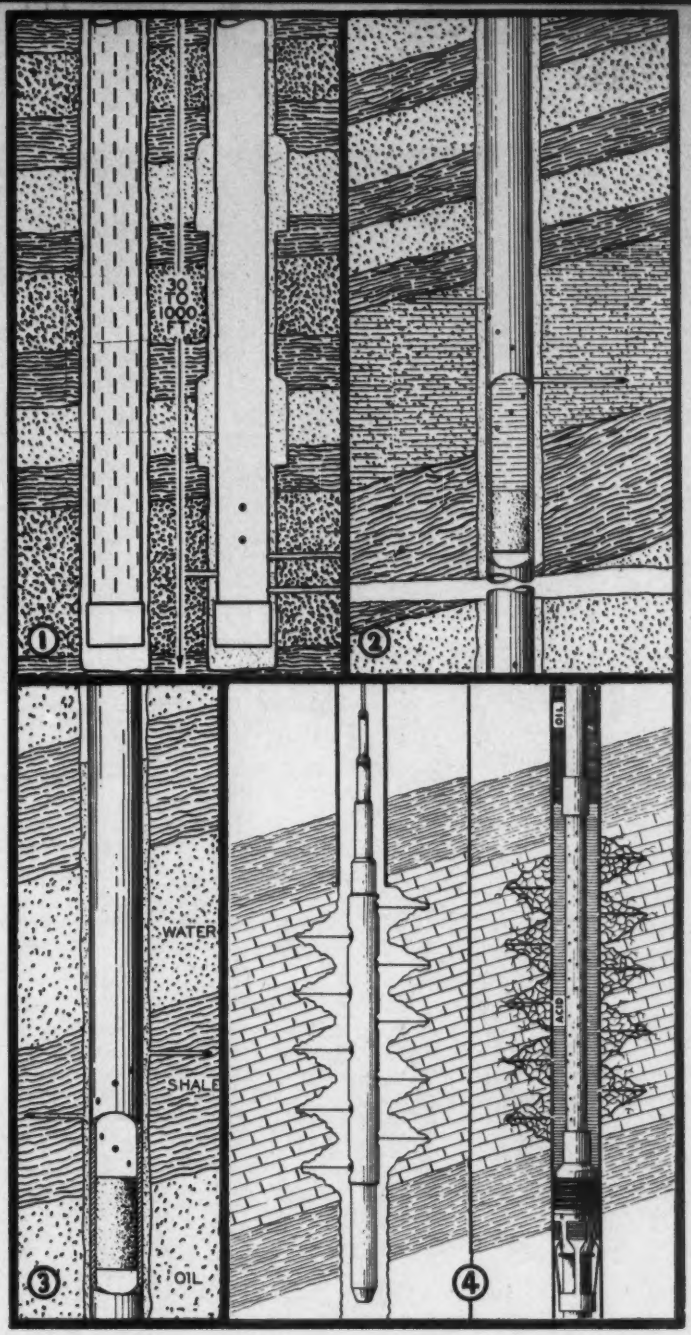

1 ***Cement Blank Liners in Wells*** —Set your casing and cement it solid throughout the entire productive horizon. Then gun perforate and produce possible zones starting at bottom and working up.

2 ***Before Abandoning Wells***— Before abandoning a well test all probable producing zones. Engineering records are usually available showing these zones and inexpensive gun testing programs justified.

3 ***For Efficient Cement "Squeeze" Jobs***—For efficient cement "squeeze" jobs, on either water or gas conditions gun perforate. Perforating makes effective and positive shots.

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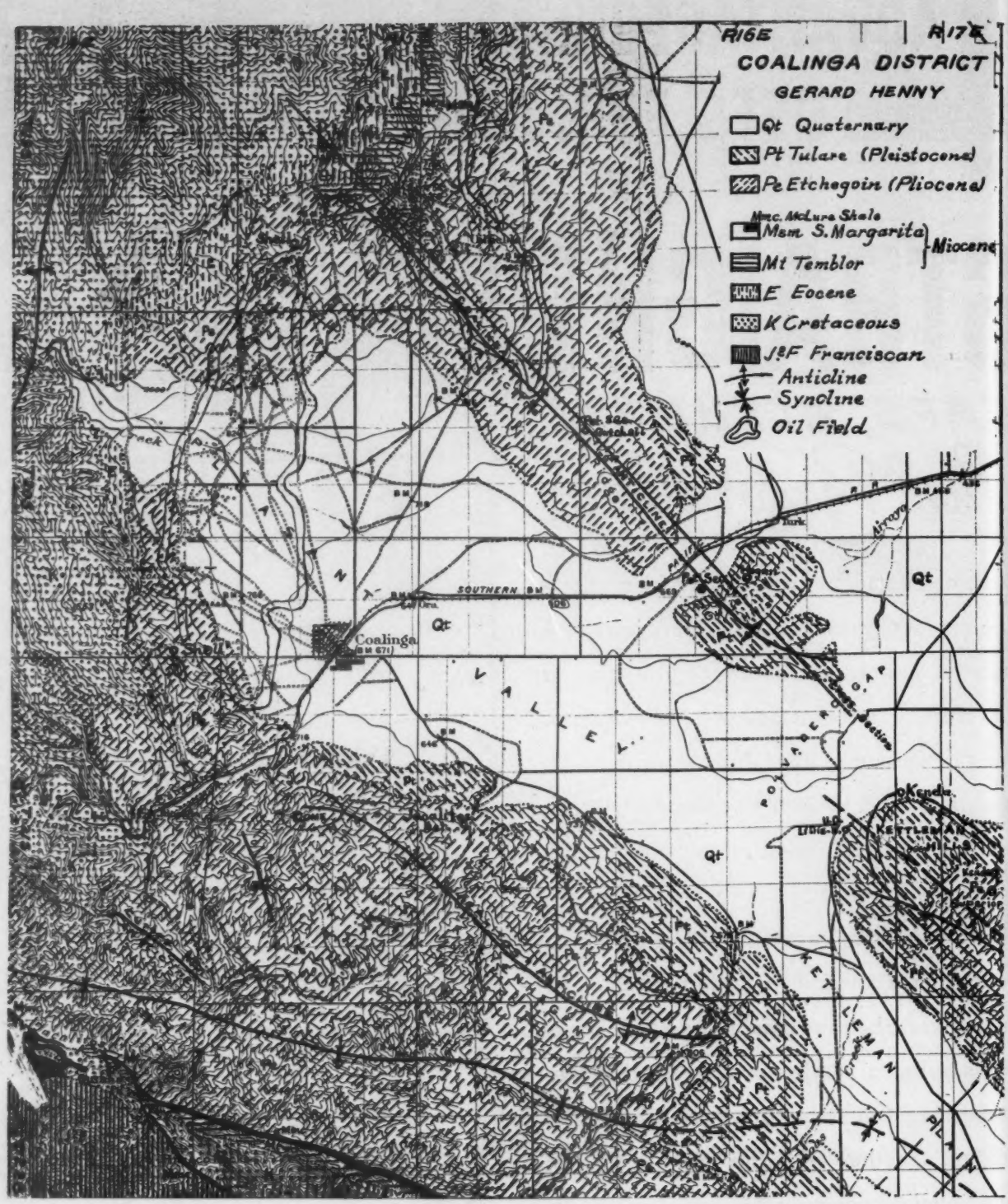


Ridge, at the southern edge of the map, the Santa Margarita is represented by the McLure Shale. The writer fully subscribes to Dr. Goudkoff's interpretation that the McLure Shale gradually changes to the north into the sands and conglomerates of the Santa Margarita in the East-Side Field. In the southwest corner of the map the McLure Shale overlies unconformably a series of sandstone beds (The photograph with this article shows this unconformity. It was taken however in a locality much farther to the northwest).

These sandstone beds were once called Santa Margarita by the writer, because they are lithologically somewhat different from the Temblor of the Reef Ridge and contain a somewhat different fauna. At the present time there seems to be some confusion as to the true age of this sandstone. It is however strange that both formations are found frequently, despite the unconformity between them.

The Jacalitos-Etchegoin has a thickness of between 2600 and 6000 ft. in the Coalinga District. Some heavy oil was

found in this formation in the old Bolsa Chica Well on the Middle Dome of the Kettleman Hills.

The Tulare Formation lies unconformably on the Etchegoin. This unconformity is very apparent near the south line of the map where the Jacalitos Anticline dips under a monocline series of Tulare, south of Zapato Creek.

The boulder beds of the Tulare formation are somewhat more resistant to erosion than the more shaley beds of the Etchegoin. This is the reason why nearly always a row of high hills is found in the Tulare near the Etchegoin contact. This fact has sometimes misled people to believe that a fault existed near this contact. Examples are found in the Guijarral Hills and along the Kreyenhagen Hills.

McLure Shale lying unconformably on upper Miocene sandstone beds.

Structural Geology

The structural interpretations on the writer's map are somewhat different from the one on Arnold and Anderson's map. The writer however wants to state that he has a profound admiration for the brilliant work of these authors. At the time their map was made, the paleontology of California was only in a state of infancy, and our knowledge of paleontology and geology in general has made an enormous progress since then. The reader must not forget that the authors had to map a vast territory on horseback and on foot.

In the south of the map is an important syncline dividing the Kettleman Hills from the Reef Ridge. It starts turning to the east near the mouth of Canoas Creek, where is passes under the Tulare formation. The syncline is not reflected in this formation lying unconformably on the Etchegoin. It continues to the east, paralleling the steep dips of Reef Ridge and it then continues farther to the northwest in Waltham Valley, outside of the limits of the map.

To the south of this syncline is a steep anticline on Reef Ridge. This anticline is located between two series of McLure Shale, both marked on the map in black. This steep anticline does not exist in the older formations. To the northwest outside of the confines of the map, on the southwest slope of Waltham Valley, the anticline becomes steeper and narrower and starts to overturn to the northeast until it changes into a thrust-fault. This thrust fault is called the "Waltham Valley Fault." It is however of minor importance.

To the north of the syncline are three anticlines "en echelon." They are the Curry Mountain Anticline, the Jacalitos Anticline and the Kettleman Hills Anticline. These three anticlines are part of one system of folding. The syncline to the north of these folds goes from Pleasant Valley, north of Coalinga, through the deep Polvadero Gap and then along the east of the Kettleman Hills. Because it is covered by Alluvium it has not been marked on the map.

North of Curry Mountain, the Curry Mountain Anticline is present only in the Etchegoin lying unconformably on the Cretaceous, the latter formation showing only a monocline series. The anticline dips to the south where it flattens out near Jacalitos Creek.

The Jacalitos Anticline forms a dome just south of Alcalde Canyon as marked on the map. This dome has not yet been drilled, but it seems that oil in commercial quantities should be found under it.

From the foregoing it results that the Kettleman Hills Anticline does not continue to the north into the Coalinga Anticline, but that the latter forms part of the Semitropic anticlinal system which parallels the Kettleman Hills to the east. Of the two anticlines, marked on the map in the Kettleman Hills, the western one is the surface anticline and the eastern one is on the top of the Temblor.

The folds were occasioned by a push from the southwest against the Sierra Granite, forming a practically unmovable block, a "horst". Generally the west flanks of the anticlines are steeper than the east flanks.

Conclusions

As we said before the Avenal Sand, being of Domengine age, lies under the Kreyenhagen Shale. The writer has found nowhere in the Coalinga District an angular unconformity between this Kreyenhagen Shale and the Domengine. That is why he thinks that oil can be trapped in the Avenal Sand only where it is overlapped by the Etchegoin. This apparently was not the case at the site of the Shell well to the north of Coalinga in section 30, 19-15, which is already abandoned. There is certainly a better chance for obtaining oil in the Shell well west of Coalinga in section 35, 20-14, where the Eocene is completely covered by Etchegoin. Therefore the writer reccommends for further study the area on the map to the south of this last Shell well, and especially the Jacalitos and Kreyenhagen Hills.

It is difficult to understand how the oil was trapped in the Petroleum Securities Gatchell well. There may be a local northwest pitch in the Avenal Sand of the Coalinga Anticline, forming a small dome, not reflected in the overlying Temblor, as is tentatively indicated on the cross-section. And again there may be a fault in the Eocene to the northwest of the well, not reflected in the Temblor. Perhaps the future will teach us here something new on the subject of oil accumulation.

Standard Cuts Price Of Fuels at San Pedro

The Standard Oil Co. of California announces a reduction in the price of fuel oil of 10c (ten cents) a barrel and of diesel oil 10c (ten cents) a barrel. This constitutes a reduction at San Pedro of one dollar ($1.00) to ninety cents (90c) for fuel oil and one dollar sixty-five cents ($1.65) to one dollar fifty-five cents ($1.55) for diesel oil. The reductions are effective May 10th at all points.

These reductions reflect a very serious situation which exists in California owing to production of crude oil far in excess of market demand. Numerous fields in California are overproducing, with Wilmington contributing a large share to the excess.

Design-Fabrication Of High Temperature

And High Pressure Piping Is Discussed

By F. C. Fantz,
Vice-President, Midwest Piping & Supply Company, Inc.

The increased use of high pressures and temperatures in the steam plants and oil refineries has forced the designer to look for a better means of joining the tubular sections that make up the piping system. The high cost of flanged joints and the difficulty of maintaining tightness under severe conditions have led to the use of welding wherever possible.

The challenge has been met and future developments along this line will find welding keeping up with the procession as the accepted method of fabrication.

Flanged joints, if used at all, are limited to such places as require dissembling for cleaning or other purposes.

Practically all present-day high temperature piping in control stations is carbon molybdenum steel, allowing a reduction in weight of about 40 per cent.

Oil refineries and industrial piping designs call for high welding technique and has made stress relieving or heat treating of the finished assembly necessary.

Special shapes, bands, etc., are fabricated in the piping contractor's shop insuring maximum weld quality and freedom from locked up stresses.

Branch and Intersection Welds

The header or manifold of today is a combination of tubing and various welding fittings pre-fabricated by welding in the shop. In some cases the valves are welded direct to the openings during fabrication and then made a part of the piping system by welding at the construction site.

The design and execution of this type of weld is much more difficult than either the Butt or Fillet welds and should not be attempted in the field.

Fred C. Fantz

The three methods of making branch connections having the widest use are shown in the following examples:

The first example, Fig. 2, is prepared for welding by inserting the branch flush with the inside diameter of the header. The end of the branch changes from a square cut at point A to a 60 degree bevel at point B. The hole in the header is also beveled.

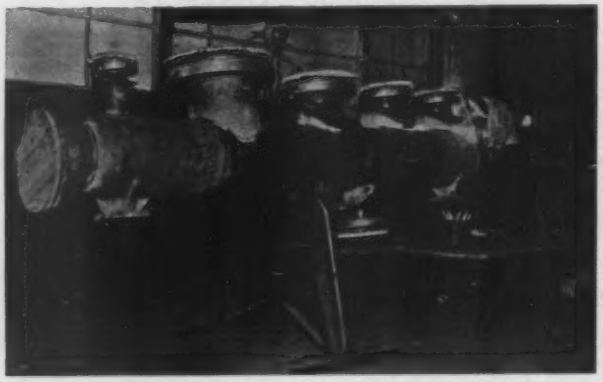
Fig. 3 shows that both the branch end and the hole in the header are beveled. Both methods require very careful layout and fitting in order to produce the proper welding groove.

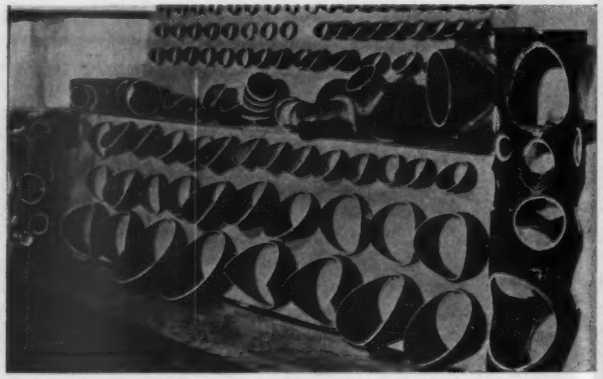
What is thought to be a better method of preparation for a branch connection is shown by Fig. 4. In all cases when this method is used, the hole in the header is cut to dimensions of the inside diameter of the branch and parallel to the side walls of the branch. This does not require an elaborate technique. The holes for small branches can be drilled or bored, the larger sizes cut with the torch either manual or machine-guided. Considerably less material is removed from the header.

The preparation of the branch pipe end is a true development of the intersection of cylinders and can be laid out on a template and transferred to the work or cut by a machine-guided torch capable of developing this intersection. Such machines have been perfected and are now on the market. When the hand-manipulated torch is used, it is held at a constant angle with relation to the axis of the pipe. This manipulation is not as difficult as in the methods previously described and can easily be handled by the average welding operator.

It should be remembered that the easier it is made for the operator to prepare the connection and deposit the weld metal, the greater assurance we have of obtaining uniform good quality welds.

When a section is cut out of a pipe and a branch is inserted, the strength of the original pipe is impaired to a degree depending upon the relation of wall thickness to the diameter of the header section. In the design of relatively short headers with many branches, it is quite common practice to make the header wall heavier than would be necessary if no holes were cut, thus averting need for additional reinforcing.





Left: A large header during the process of welding the branch connections. This work is supported by the rollers in the foreground and revolved by a machine so that the weld is made in a downward position. The operator is controlling the revolving machine with a switch operated by his left foot. Note that the saddles are slipped up on the branch pipes. The saddle for the large opening is left off as it would interfere with the pressure weld. It is later put on in two sections and welded.

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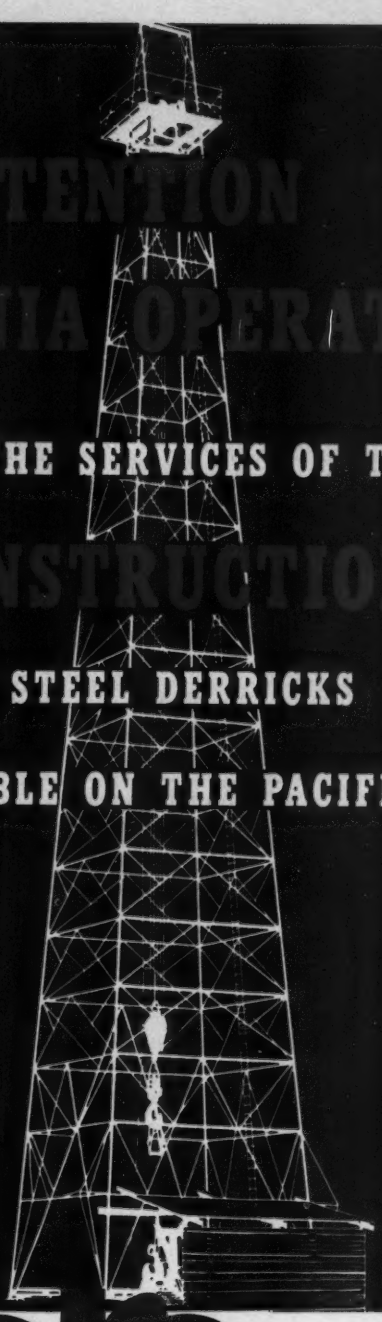

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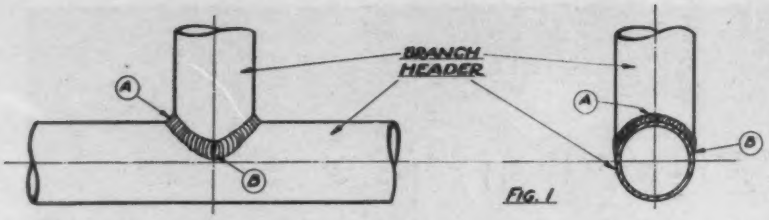


FIG. 1

TYPICAL CROSS SECTIONS BELOW ARE TAKEN AT POINTS INDICATED BY LETTERS A AND B ON ABOVE LAYOUT.

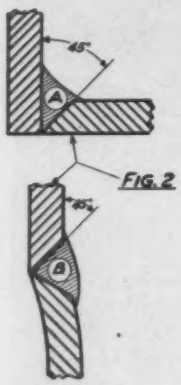


FIG. 2

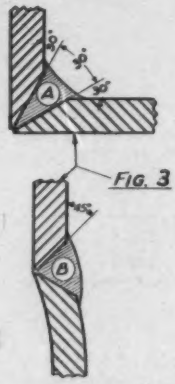


FIG. 3

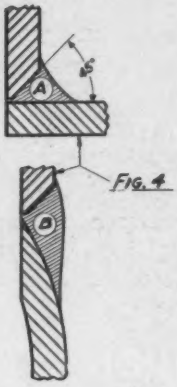


FIG. 4

When the wall thickness is based on pressure and temperature conditions, some form of reinforcing the branch connection is necessary. Where the branch pipe diameter is one-third, or less, then the diameter of the header, it is thought that the addition of a weld metal properly applied would act as a reinforcing ring. As the size of the branch increases in relation to the diameter of the header, additional reinforcing is required.

As the design approaches size on size (12" branch to a 14" header), the flat portion at B, Fig. 1 must be considered. The increased cross-sectional area at this point concentrates a greater strain at point A; and if pressure is raised to the bursting point, rupture will always occur at this point. The use of gussets or flat ribs between the branch and header have not proved satisfactory and have been replaced with a ring or saddle.

The ring type can be made without the use of dies and can be cut and rolled or shaped to the header in the field. For this reason the ring type is advocated by some engineers. However, reinforcing saddles can be obtained from stock of several manufacturers in the sizes given in the following Table. The cost of the finished assembly will compare very favorably with the ring plate type:

Nominal Size of Nozzle	Nominal Header Sizes	A	B	C	R
2	2 to 24	1¼	1¾	½	½
2½	2½ to 24	1½	1¾	½	½
3	3 to 24	1¾	2	½	½
3½	3½ to 24	1¾	2	½	½
4	4 to 24	2	2	½	¾
5	5 to 24	2	2	½	¾
6	6 to 24	2¼	2½	½	¾
8	8 to 24	3	3	⅝	1
10	10 to 24	3½	3½	⅝	1
12	12 to 24	4	4	⅝	1¼
14 OD	14 to 24	4	4	⅝	1½
16 OD	16 to 24	4	4	⅝	1½
18 OD	18 to 24	4	4	⅝	1½
20 OD	20 to 24	5	5	⅝	1½
24 OD	24	5	5	⅝	1½

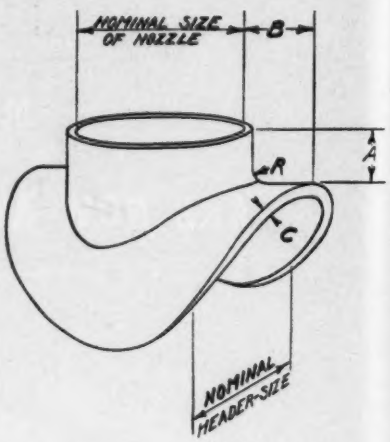


FIGURE 7

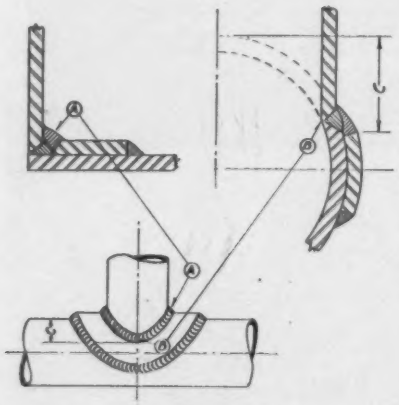


FIGURE 5

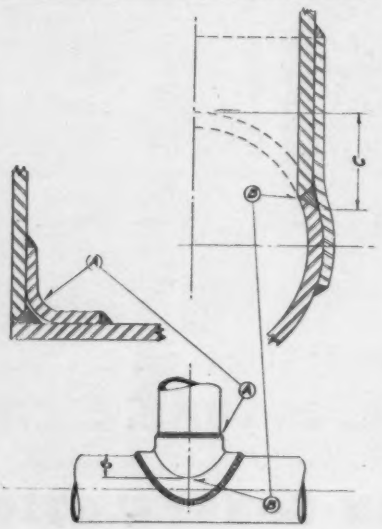


FIGURE 6

The ring portion of the saddle not only supports the flat section of the connection, but it also tends to relieve the weld of concentrated strains set up by movement of the connecting branch line caused by expansion and contraction, or so-called hammer shock.

Where the ring or saddle is applied to assemblies which are to be later stress relieved or annealed, a small hole should be drilled through the reinforcing member to relieve pressure that may build up due to expansion of entrapped air or gas. Serious deformations have been observed in large diameter pipes when this precaution was not taken.

Photographs A and B show typical examples of branch connections reinforced with saddles, as well as stock fittings used to make up the desired assemblies.

Another design of branch connections that is proving quite successful for high

Latest type pumping installation in Signal Hill Field served by Southern California Edison Company. Silent chain drive—entirely weatherproof. Shown complete with transformer and metering equipment.

The deep hum of the motor and the smooth action of the pump are music to your ears when electricity is handling the job. Sweet music, too, is your auditor's report on monthly pumping costs because electricity is noteworthy for economical operation.

Electric pumping has proved its efficiency on the toughest possible assignments. If you are interested in dependable, uninterrupted pumping service and low cost per barrel, get in touch with an Edison engineer. His services are available without cost to any operator in Edison territory.

ELECTRICITY *at work in the oil fields*

SOUTHERN CALIFORNIA EDISON COMPANY LTD.

5-38

pressures and temperatures is made by welding two or more branches into a welding head. The head should be of heavier wall material to compensate for the reduction in strength of the openings.

High pressure piping should be prefabricated in a shop as much as possible in order to obtain the quality required. The shop has the following advantages:

Trained personnel steadily employed in the research, design and supervision of this class of work.

Equipment designed especially for pipe fabrication.

Special machines and welding operators continuously employed for high pressure fabrication.

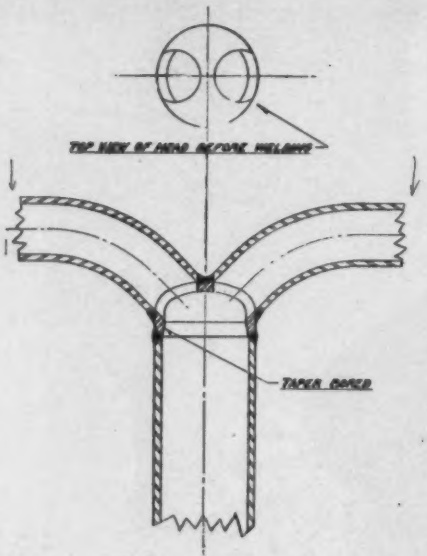


FIGURE 8

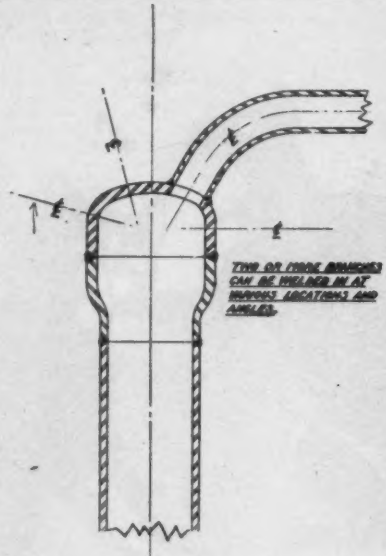
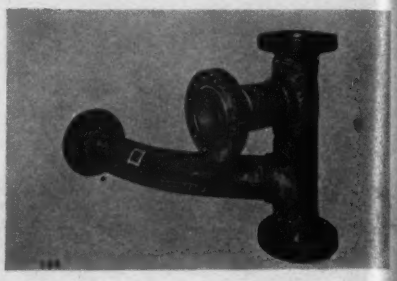
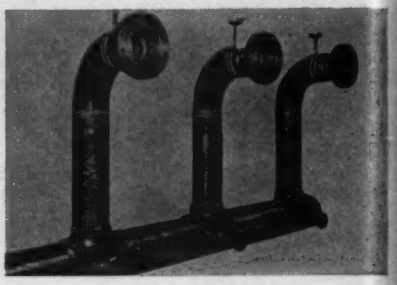


FIGURE 9

The accompanying pictures are shown to illustrate some of the equipment and methods used in our shops, also to show typical examples of fabricated piping used in power shops, also to show typical examples of fabricated piping used in power plants, oil refineries and industrial plants:



Photographs A and B



A. O. Smith Tower Weighs 200 Tons

One of the heaviest pressure vessels ever built was shipped a few days ago by the A. O. Smith Corp., Milwaukee, Wis., to the Gulf Refining Co. at Port Arthur, Tex. It marked the A. O. Smith Corp's eighth pressure vessel shipment to the Port Arthur refinery in the last three months.

Weighing 393,800 pounds—nearly 200 tons—this separating tower has an overall length of 61 feet, an outside diameter of 12 feet and a maximum wall thickness of 3¾ inches. Of electric-welded steel plate construction, it was lined on the inside with a corrosion-resisting chromium alloy by the patented Smith lining process

Th ehuge tower presented a difficult transportation problem. It was even proposed to float it through the Great Lakes and down around Florida. After careful study, however, a routing by rail was worked out by A. J. Bessolo, Pittsburgh, Pa., general traffic manager of the Gulf Oil Corp. It involved enlisting facilities of six different railroads in order to secure safe clearance. Ten days were required for the shipment to make the 1,000-mile trip from Milwaukee to Port Arthur because it could only be moved by daylight and at not more than 25 miles an hour.

Two flat cars, especially constructed to carry the enormous weight, were used and special blocking and swivels were employed to permit rounding of curves en route. The supporting brackets were left off two sides in order to bring the shipment within railroad clearances. The brackets must be bolted in place at the refinery.

The shipment was reported to be the greatest freight handling feat since the famous 200-inch telescope mirror was moved from Corning, N. Y., to Mount Palomar, Calf., two years ago.

The Adult Education Section of the Los Angeles City Schools is conducting a series of adult forums, on one of which "Science and Technology Forum," appears the subject, "Science Develops a Future for Petroleum."

Exempting issues of $100,000 or less from registration, but maintaining a close supervision over terms and conditions of offerings for protection of the investing public, the Securities and Exchange Commission has just issued new regulations governing issues of certificates of interest or participation in gas and oil royalties.

Guy E. Daniels has been named export representative for the Wilson Manufacturing Co. of Wichita Falls, Texas. Wilson manufactures portable rotary rigs and oil field winches. H & B Sales Co., Ltd., 2875 Cherry Ave., Long Beach, are their California distributors.

Transfers of field representatives also have been made within the Wilson organization. J. V. Wintle is now located in Tulsa, Oklahoma, and is in charge of sales activities of Oklahoma and Kansas.

Russell Moore, who formerly was sales representative in West Texas, has been transferred to South Texas with headquarters at Houston.

A second edition of Section 11, of the booklet, "Disposal of Refinery Wastes," has been published by the American Petroleum Institute's Division of Refining.

ACCURACY *spells* ECONOMY

. . . and is assured by the precise care given all oil treating problems by Tretolite. Nothing is left to chance in the development of the proper Tretolite formulas for your specific requirements in preparing crude oil for pipe lines.

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Manufacturing Chemists

DALLAS ST. LOUIS LOS ANGELES

Representatives in all Principal Fields

THE recent discovery of many new fields in California is, to a large extent, due to the wide use of the Seismograph in locating test wells. Simplified, the procedure followed in seismic surveys is to fire a charge of dynamite below the surface of the earth, the vibrations from which are recorded on a very sensitive instrument located some distance away. As the speed and intensity of the shock, as recorded, vary proportionally with distance and density of the formation, and the first three being known, the latter factor may be calculated. A large number of these "shots" within a given area enables engineers to plot general structural trends with reasonable accuracy.

In the upper left, one of the crew of a "seismo" party is plugging a shot hole which otherwise would be dangerous to cattle. To the right, a final check is made by portable telephone with recorder operators before firing the shot. Lower left shows "chief of party" developing a photographically recorded seismogram or shot record. The truck is picking up cables and equipment before moving to another "setup."

—Photographs courtesy of Superior Oil Company.

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WHEN YOU SWITCH TO TRITON

IN 1000-CAR TEST, TRITON STOPPED CARBON KNOCKS...BOOSTED HORSEPOWER 5.4% ...INCREASED GAS MILEAGE!

Here's proof that Triton gives the finest type of lubrication any oil can give—*and in addition cleans out carbon as you drive!* Proof from 1024 owner-drivers in a recent research test!

Carbon knocks were greatly reduced or completely stopped in every test car finishing 3000 miles with Triton!

Horsepower picked up an average of 5.4%.

Two-thirds of the car owners reported increased gasoline mileage.

Triton gives these results because it is propane-solvent refined...100% *pure* paraffin-base...100% *pure* lubricant. Triton forms so little carbon that motors burn away old carbon left by other oils. Carbon "ping" is changed to "purr"!

You save four ways with Triton Motor Oil. You save on carbon scrapes, gasoline, motor wear, and oil drains.

Try Triton next time you buy oil!

PRODUCT OF UNION OIL COMPANY

F. A. Morgan Elected Richfield Vicepresident

Richfield Oil Corp. announces the election of Frank Albert Morgan as vice-president of the company.

Mr. Morgan was born in Sonora,

Tuolumne County, Calif., Jan. 14, 1898. Following his graduation from the College of Mining and Geology of the University of California, Mr. Morgan in 1920 began serving various oil groups as consulting geologist and petroleum engineer.

In 1929 Mr. Morgan joined the Rio Grande Oil Co. as chief geologist and subsequently appointed vice-president and member of board of directors. Upon reorganization of Richfield and its merger with Rio Grande in March, 1937, Mr. Morgan joined Richfield, the successor company.

Kerotest Official Is Coast Visitor

Harry C. Potts, vice president of Kerotest Manufacturing Co., Pittsburgh, Pa., was a recent visitor on the Coast.

Mr. Potts accompanied by Joe Swaton, Pacific Coast representative for Kerotest, spent considerable time calling upon the oil trade. Mr. Potts reported that conditions on the Coast looked very favorable and that national business was exceeding their expectations.

Approval of a project to survey state marketing laws was announced today by Corrington Gill, Assistant Administrator of the Works Progress Administration.

California Standard Election of Officers

The regular annual meeting of the stockholders of the Standard Oil Co. of California was held recently and the following board of directors was elected—W. H. Berg; H. D. Collier; R. W. Hanna; R. K. Davies; M. E. Lombardi; J. H. Tuttle; G. E. Kennedy; A. S. Russell, P. H. Patchin, and R. C. Stoner.

The board in turn elected the following officers—W. H. Berg, president; H. D. Collier, vice-president; R. W. Hanna, vice-president; R. K. Davies, vice-president; M. E. Lombardi, vice-president; J. H. Tuttle, secretary; V. F. Palmer, treasurer; G. J. O'Brien, assistant treasurer; B. W. Leicher, assistant secretary; G. M. Foster, assistant secretary; Lee Laird, assistant secretary.

San Joaquin Oil Men To Hold Annual Feast

San Joaquin Oil Men are completing arrangements for their fourth annual Barbecue and Golf Tournament, at Stockdale Country Club, Bakersfield, June 4.

These annual sessions have been the means of getting together oil men who otherwise have little opportunity to see each other. The barbecue and tournament are attended by oil men from over the entire state, who are assured a cordial welcome and royal entertainment.

First Wiggins Balloon Showing in California

The first demonstration in California of the Wiggins Steel Balloon was held recently at the Shell Oil Co. refinery at Dominguez. The exhibition was witnessed by some 35 engineers and officials of the California oil fraternity. The structure is a Wiggins Steel Balloon with a capacity of 350,000 cu. ft., is 200 ft. in diameter, and is essentially a gas holder used for collection of vapors from tanks and storing volatile products.

Vapors from ordinary storage tanks flow through vapor lines into the balloon. A slight pressure (1 inch w.p) will start the balloon to flex and maximum operating pressure is 1 5/8-in. water.

The balloon was fully inflated with air and inspected in this position. It was then rapidly deflated and its movement observed with much interest. The extremely low operating pressure enables it to be used in connection with conventional storage tanks with steel roofs equipped with standard vent valves.

John H. Wiggins, the inventor, was present, as was D. E. Larson, in charge of development engineering for the Chicago Bridge & Iron Works Co., of Chicago.

Blowout Preventer Saves Potrero Hills 1

A spectacular blow-out occurred recently when Richfield Oil Co.'s Potrero Hills No. 1, wildcat in sec. 10, 4n-1w west of the Rio Vista gas field, pulled a wire line core barrel from bottom at 3250 ft. The drill broke through a hard shale formation into soft sand and a core was taken. Apparently the core barrel coming out had the same effect as pulling a swab, the gas from the last three feet of hole throwing the barrel to the crown. On replacing the kelly and pumping in mud, gas started blowing around the drill pipe and a disaster was averted only by the effectiveness of the blowout preventer which functioned perfectly. Pressure built up to 600 lbs. causing the surface casing to leak and small quantities of gas came up through the ground around the rig, necessitating bleeding the casing at an estimated rate of 3,000,000 cu. ft. After killing the gas with heavy mud, the drill pipe was found to be frozen in the hole and the company is now attempting to free it in order to continue drilling.

Union Oil Co. Fishing Outing

A party of fishermen, mostly from Union Oil Co., rounded up by that exhuberant Waltonian—Rube Brown—set sail from Newport Harbor in the rain one recent Saturday morning about 6:30 a.m. Not only did it rain—it also blew, and the sea was quite badly behaved, so badly, in fact, that two highly respected members of the party lay down on the job and refused to do any fishing.

With the aid of the boatman, Bill Hopkins caught a five pound bass and the sweepstakes for the biggest catch of the day. Without the aid of anybody, another lineman caught a three-ounce mackerel and a bad cold. Everybody had a swell time, excepting the two unfortunates already mentioned, and it would really have been a first-class outing, if the boat hadn't rocked so much, and if the sacks hadn't got so badly mixed up on the way home. As it was, the poorest fisherman took home the most fish, and all the good ones had to show was vice versa.

There were 22 aspiring bait heavers present, representing Union's gas, field, pipeline, and head office, and in spite of the ill luck that dogged them on this voyage, they have decided to do it again real soon.

Russell D. Wood

Born January 23, 1905 at Colorado Springs, Col. Lived there 20 years. Attended Colorado College. Spent summers in Taft working in capacity of glazer and painter for Honolulu Old Corp. Started working in Honolulu Gasoline Plant gang in 1925. Transferred to Laboratory. Soon after to Gas Measurement. Now in that work

Interested in C.N.G.A. at a tender age. Taft Chapter Secretary June 1934 to June 1937. Chairman, June 1937 to date. Member of Committee on Proving of Gasoline Meters.

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CNGA

May, 1938

This section, a regular monthly feature of the California Oil World, is devoted to the activities of the California Natural Gasoline Association. The California Oil World is the exclusive official publication of the California Natural Gasoline Association, so designated by vote of the Association Executive Committee in a meeting on August 19th, 1937.

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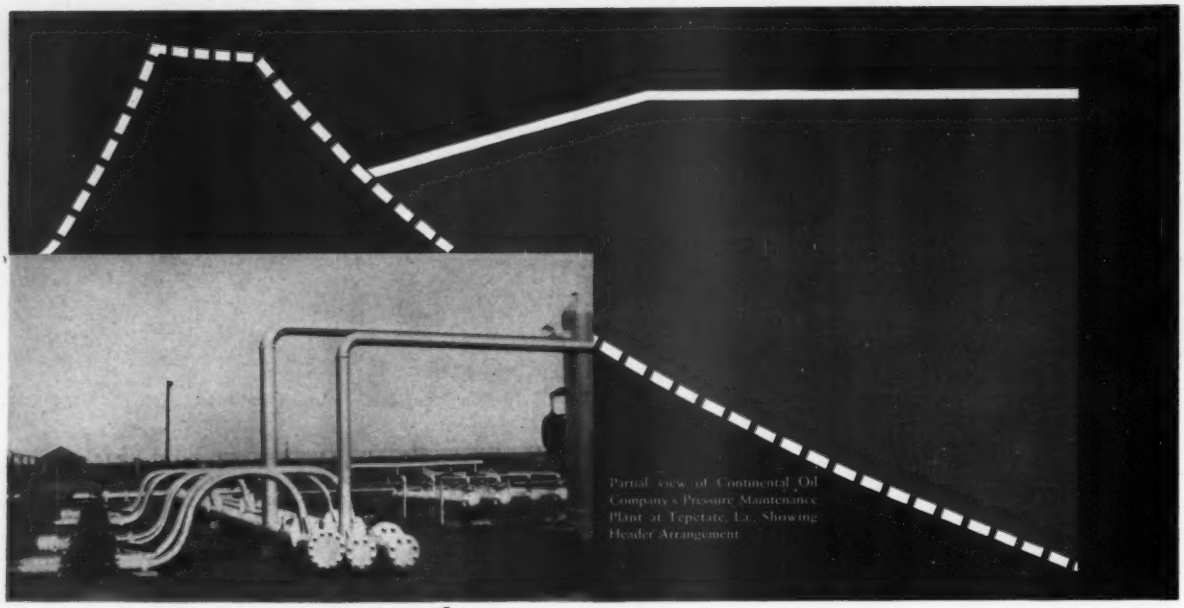
LEVEL YOUR PRESSURE CURVE



Partial view of Continental Oil Company's Pressure Maintenance Plant at Tepetate, La., Showing Header Arrangement

WITH PRESSURE MAINTENANCE!

Increase the life and value of your investment; secure the maximum recovery of oil, gas and natural gasoline; prolong the life of your wells; return dry gas underground for conservation and future use! Secure these and many other added profit-building advantages by leveling your pressure curve through repressuring!

Through this value-proven method, dry gas is returned to the oil bearing sand under pressure sufficiently high to guarantee complete penetration. Pressure maintenance, through repressuring, permits a constantly close approach to the original rock pressure. Records exist of supposedly depleted fields being returned to high productivity with the recovery of many added millions of barrels of oil through the use of this method. Natural gasoline production is maintained at maximum for the greatest number of years and added profits result from elimination of blow-off and the consequent upbuilding of an underground gas reserve which assures continuance of profitable gasoline plant operation.

We are prepared to construct such plants for any pressure condition based upon the requirements of your production engineers. We invite inquiry.

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Equilibrium Relations For Paraffin Series

Hydrocarbons At High Pressures And Ordinary Temperatures

By ROBERT B. BOWMAN,

Research and Development Department, Standard Oil Company of California

The original request of the Program Committee was for a paper on "Fugacity". The present title was considered preferable, though, not only because it avoids emphasizing a concept which may be unfamiliar to some, but also because the intention is to present the subject-matter in a manner closely related to the conventional methods of solving problems involving equilibria between liquids and vapors.

It is now generally recognized that pressure-volume-temperature relationships derived on the basis of ideal gas laws can be applied with an accuracy sufficient for engineering computations over only relatively limited ranges of temperatures and pressures. For this reason, attempts have been made by various investigators, particularly within the past six or seven years, to establish accurate P-V-T relations for members of the paraffin series of hydrocarbons which are of fundamental importance to the producing, refining and natural gasoline divisions of the petroleum industry. Experimental data from which these relations have been derived, however, in general have been confined to the range of conditions normally encountered in refining operations where high pressures are usually accompanied by correspondingly high temperatures. It has been customary practice to extrapolate these data, then, to the range of considerably lower temperatures which prevail in natural gasoline operations. The result has been that, for the most part, P-V-T relations extrapolated to the latter range of conditions could be used only with caution.

Preliminary published data were not only of questionable accuracy in the range of high pressures and ordinary temperatures, but they were somewhat inconvenient for practical use because the concept of "fugacity" was introduced. The use of this term has in many cases given the impression that the application of revised P-V-T relations would require making a rather radical departure from the older methods of computation. However, as is shown below, it is possible to introduce the more accurate relations into equilibrium computations simply in terms of a factor for correcting vapor pressure. The result is that the customary partial pressure—vapor pressure methods may still be applied, the only modification being the introduction, wherever vapor pressure appears in the computations, of a multiplier which may be conveniently read from a chart.

This paper has been prepared for the purposes of (1) illustrating the application of a term known as "vapor pressure correction factor" in computations involving paraffin hydrocarbons (in general this factor need be applied only at pressures exceeding 100 lbs./sq. in.); (2) presenting a method for determining the extent to which the behavior of hydrocarbons departs from predictions made on the basis of ordinary partial pressure-vapor pressure relations; (3) presenting data on the departure from ordinary partial pressure-vapor pressure relations exhibited by paraffin hydrocarbons at pressures up to 600 lbs./sq. in. and temperatures over the range from 40° to 140° F.; and (4) applying this information to natural gasoline plant practice by determinations of (a) a reliable relation between oil circulation and absorber pressure required to maintain a specified absorption factor and (b) the effect of high pressure on losses of gasoline fractions resulting from vapor pressure of lean oil.

I. Fundamental Considerations

A. THE "VAPOR PRESSURE CORRECTION FACTOR".

The departure from ideal gas properties exhibited by paraffin hydrocarbon vapors causes each constituent of a liquid hydrocarbon mixture to behave as though it had a vapor pressure different from its "normal vapor pressure," unless the total pressure on the surface of the liquid is equal to the "normal vapor pressure" of the hydrocarbon at the temperature of the system. By "normal vapor pressure" is meant the pressure exerted by a single-component hydrocarbon vapor when in equilibrium with the liquid from which it is formed. This property is available from ordinary vapor pressure charts such as Diagram I.

Robert B. Bowman

At total pressures higher than the normal vapor pressure of a liquid hydrocarbon, the latter appears to be more volatile than its normal vapor pressure would indicate. In other words, its concentration in the vapor phase is found to be higher than that computed from partial pressure-vapor pressure relations. Conversely, if the total pressure on the system is lower than the normal vapor pressure of the liquid hydrocarbon, the latter appears to be less volatile than its normal vapor pressure would indicate. Its concentration in the vapor phase is then less, and in the liquid phase greater, than would be indicated by computations based on ordnary partial pressure-vapor pressure relations.

It might be stated, therefore, that except in cases where the total pressure on a system is equal to the normal vapor pressure of the hydrocarbon under consideration, the latter behaves as though it has an "effective" vapor pressure different from its normal vapor pressure. The "vapor pressure correction factor" is simply a multiplier for converting normal vapor pressure of a hydrocarbon to the corresponding "effective" vapor pressure at specified conditions of temperature and total pressure. If the total pressure is higher than the corresponding normal vapor pressure, the vapor pressure correction factor will have a value greater than 1.00, and if total pressure is lower, the correction factor will be less than 1.00.

The basic equation for computing vapor-liquid equilibrium relations under the assumption that the vapor behaves in accordance with properties of an ideal gas, is the following:

$$p \cdot x = P \cdot y, \qquad \text{Equation (1)}$$

wherein p = normal vapor pressure of the hydrocarbon being considered; x = mol fraction of this hydrocarbon in the liquid phase; P = total pressure on system; and y = mol fraction of the hydrocarbon in the gas phase.

The above equation expresses the fact that equilibrium in a system is attained with respect to an individual component when the product of its normal vapor pressure times its mol fraction in the liquid phase, in accordance with Raoult's law, is equal to the product of its mol fraction in the gas or vapor phase times the total pressure on the system, in accordance with Dalton's law. However, due to the large deviations from the behavior of ideal gases exhibited by the vapor from the paraffin hydrocarbons, Equation (1) is even approximately true over only a relatively narrow range of pressures.

Introduction of the vapor pressure correction factor into Equation (1) gives rise to an expression which represents true equilibrium relationships for any conditions for which values of the correction factor are known.

$$c \cdot p \cdot x = P \cdot y, \qquad \text{Equation (2)}$$

wherein c = vapor pressure correction factor, the remaining terms being the same as those used in Equation (1).

It will be observed that the only difference between these equations is that in Equation (2) the expression "$c \cdot p$" has replaced the term "p" in Equation (1). That is, departures from conventional partial pressure-vapor pressure relationships are fully taken into account simply by using the product of normal vapor pressure times the appropriate vapor pressure correction factor wherever the normal vapor pressure alone would ordinarily be used.

Equation (2) may be considered the basis for all methods of computing vapor-liquid equilibria, such as absorption factors, dew points, bubble points, the extent of condensation resulting from compressing or cooling a vapor, and conversely the extent of vaporization resulting from heating or reducing the pressure on a liquid. Actual derivation of the formulae for these methods has been omitted because this information in terms of Equation (1) is already available in various publications. The only modificaton required is simply to insert the multiplier "c" wherever vapor pressure appears.

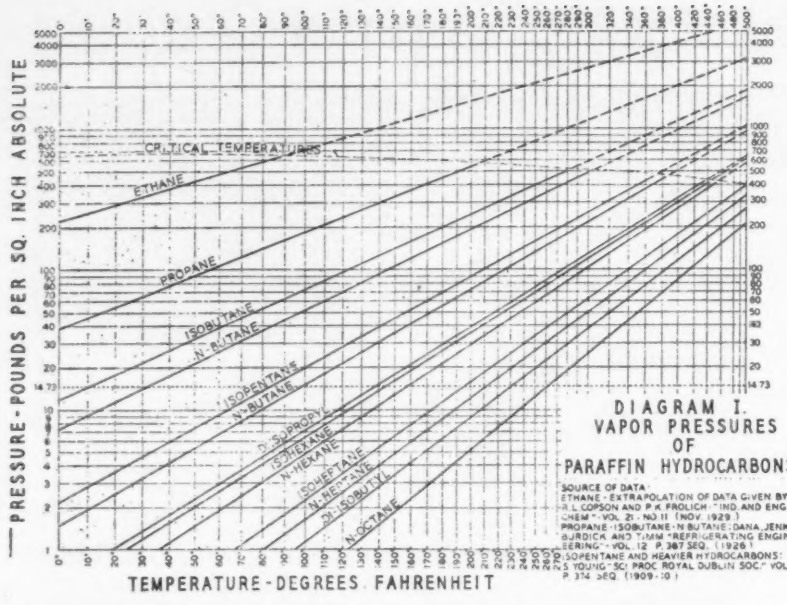
Applications of the vapor pressure correction factor in studies of absorber operation and performance are discussed in detail below. However, it will be of interest also to point out briefly other instances where computations of equilibria at high pressures and ordinary temperatures are useful.

Perhaps the most important application in the natural gasoline industry is in the computation of hypothetical plant materials balances. Information on the volume and composition of plant intake gas is all that is required to compute the quantities and compositions of liquids and vapors at every point in the process for any given set of operating conditions. Comparative materials balances for different sets of conditions or alternative methtods of operation will serve as the basis for (1) determining the most efficient and economical method of operation for a new plant or (2) estimating the extent to which improvements or simplifications are possble in existing plants. Similar computations are applicable to refinery vapor recovery and rectification systems.

Data on equilibrium relations for hydrocarbons over the range of conditions considered in this paper, are of value in oil production operations such as studies of the most suitable operating pressures and number of stages of separation between oil and gas, and problems involving compression of natural gas to high pressures for gas-lift or repressuring purposes. In pipe line operations, it is important to know for all conditions of flow whether the material in the line is a liquid, a vapor, or a mixture of liquid and vapor. Dew point and bubble point computations will indicate which condition exists.

As stated above, procedures for making computations of the type required in such studies are already available in terms of Equation (1). Introduction of the vapor pressure correction factor in accordance with Equation (2) serves the twofold purpose of (a) providing a method for improving the accuracy of computations involving paraffin hydrocarbons at high pressures, and (b) accomplishing this in a simple manner which avoids the use of an unfamilar concept with its attendant complications.

The concept of "Fugacity" was originally introduced by Gilbert N. Lewis and Merle Randall in their book on "Thermodynamics", to represent the true conditions of equilibrium between liquid and vapor phases. The correlation between "fugacity" and the vapor pressure correction factor is developed in Appendix I.


PRESSURE - POUNDS PER SQ. INCH ABSOLUTE
TEMPERATURE - DEGREES FAHRENHEIT
CRITICAL TEMPERATURES
ETHANE
PROPANE
ISOBUTANE
N-BUTANE
ISOPENTANE
N-PENTANE
DI-ISOPROPYL
ISOHEXANE
N-HEXANE
ISOHEPTANE
N-HEPTANE
DI-ISOBUTYL
N-OCTANE
DIAGRAM I.
VAPOR PRESSURES
OF
PARAFFIN HYDROCARBONS
SOURCE OF DATA:
ETHANE - EXTRAPOLATION OF DATA GIVEN BY R.L. COPSON AND P.K. FROLICH - "IND. AND ENG. CHEM." VOL. 21 - NO. 11 (NOV. 1929)
PROPANE - ISOBUTANE - N BUTANE: DANA, JENKINS, BURDICK AND TIMM "REFRIGERATING ENGINEERING" - VOL. 12 P. 367 SEQ. (1926)
ISOPENTANE AND HEAVIER HYDROCARBONS: R.S. YOUNG - SCI. PROC. ROYAL DUBLIN SOC." VOL. 12 P. 374 SEQ. (1909-10)

In published data on equilibrium relations, reference is frequently made to an "equilibrium constant," designated as "k", which is a convenient term for application in computations. It is defined in accordance with Equation (1) as:

$$k = \frac{y}{x} = \frac{p}{P}. \qquad \text{Equation (1a)}$$

The equilibrium constant is related to the vapor pressure correction factor in terms of Equation (2) as:

$$k = \frac{y}{x} = \frac{c \cdot p}{P}. \qquad \text{Equation (2a)}$$

B. PUBLISHED DATA ON EQUILIBRIUM RELATIONS.

When the investigation covered by this paper was initiated some three years ago, actual experimental data from which vapor pressure correction factors could be computed for the range of temperatures and pressures encountered in natural gasoline operations, were available only for propane. The solubility of methane in liquid hydrocarbons also had been investigated in considerable detail. The only sources from which corresponding vapor pressure correction factors could be computed for other paraffin hydrocarbons were generalized relationships derived principally on the basis of experimental data obtained at temperatures much higher than those predominating in a natural gasoline plant.

Data on propane from which vapor pressure correction factors could be computed, were published under the title "Phase Equilibria in Hydrocarbon systems: Part II—Methane-Propane System", by Sage, Lacey and Schaafsma, in the February, 1934, issue of "Industrial and Engineering Chemistry". Correction factors based on this information are shown graphically on Diagram II. They are plotted on a vertical logarithmic scale versus lines of constant temperature and a simple numerical horizontal pressure scale.

Diagram II is interpreted as follows. Let us assume that we are dealing with propane in a mixture with other hydrocarbons at a pressure of 450 lbs./sq. in. absolute and a temperature of 100°F. The corresponding vapor pressure correction factor is shown to be about 1.38. That is, propane under these conditions behaves as though it had a vapor pressure 38% higher than the value which would be read from Diagram I. In other words, the "effective" vapor pressure of propane is not 187 lbs./sq. in. absolute, but 1.38 times this figure, or 258 lbs./sq. in. absolute. It is evident that a difference of this magnitude is of real significance in the design and operation of equipment to function under these conditions.

The derivation of generalized equilibrium relationships for paraffin hydrocarbon has been undertaken principally by Dr. G. G. Brown and associates at the University of Michigan, and by Dr. W. K. Lewis, Dr. J. Q. Cope, and others at Massachusetts Institute of Technology. As has been stated, the general tendency has been to base them on experimental data obtained at both high temperatures and high pressures, and to extend them to include the range of ordinary temperatures. An attempt to use these relationships as the basis for an analysis of high pressure absorber operation at Kettleman Hills led to the conclusion that departures from ordinary equilibrium relationships exhibited by normal butane and the heavier hydrocarbons were appreciably lower than those indicated. It was for this reason that the investigation discussed in Part II of this paper was initiated.

On Diagram III are shown vapor pressure correction factors derived from (1) experimental determinations, (2) data published by Dr. Brown and associates, and (3) data published by Dr. Lewis and associates. It is evident that published data actually indicate vapor pressure correction factors for normal butane which are appreciably in excess of those determined experimentally in our Santa Fe Springs laboratory. In the range of operating conditions prevailing in Kettleman Hills high pressure absorbers (450 lbs./sq. in. and 90-120°F), correction factors computed from Dr. Brown's data are from 15 to 20% higher and those computed from Dr. Lewis' data are approximately 30% higher. Expressing this discrepancy differently, Dr. Brown's relations indicate the difference between normal vapor pressure and effective vapor pressure at a total pressure of 450 lbs./sq. in. to be 83% of the normal vapor pressure of normal butane at 120°F., as compared with a difference of only 54% which was determined experimentally.

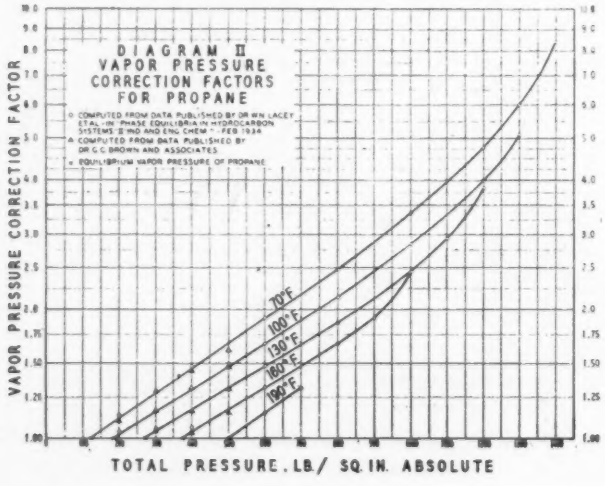
It must be mentioned, however, that vapor pressure correction factors for propane computed from Dr. Brown's data are in close agreement with corresponding factors based on experimental data. This close agreement for propane, in contrast to the relatively wide disagreement between published and experimental data for normal butane, may possibly be explained by the fact that Dr. Brown's equilibrium relations at ordinary temperatures are believed to have been extrapolated from experimental data available near the critical. This procedure would require a less extensive extrapolation for propane (critical temperature 210°F.) than for the heavier hydrocarbons.

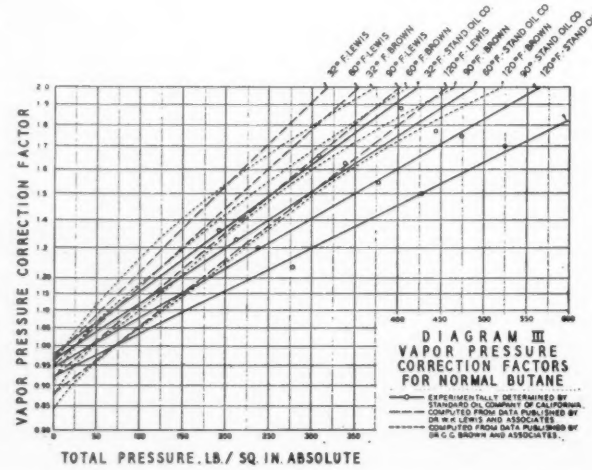
The comparison shown on Diagram III is intended in no way to detract from the value of published generalized equilibrium relationships, but rather to emphasize the need for obtaining experimental data on butane and heavier hydrocarbons in the range of ordinary temperatures. These generalized relationships have not only been adequate at high temperatures, but they have also directed attention towards the importance of modifying, wherever high pressures are encountered, the previously accepted partial pressure—vapor pressure basis of interpreting vapor-liquid equilibria.

II. Experimental Determination of Vapor Pressure Correction Factors

Departures from ordinary equilibrium relations exhibited by the paraffin hydrocarbons are due primarily to deviations in behavior of their vapors from laws applying to ideal gases. It is possible from thermodynamic considerations to compute reliable equilibrium relations if the actual properties of these vapors and of the liquids from which they are formed are accurately known. However, the low vapor pressures of members of the series heavier than ethane greatly limit the range of pressures and temperatures under which their vapors may be studied in the pure state. On the other hand, properties of these vapors in binary mixtures with methane may be determined over a very wide range of conditions if it is assumed that the presence of methane has a negligible influence upon the behavior of the heavier component.

An alternative procedure to basing equilibrium relationships on properties of separate vapor and





liquid phases is, therefore, to study binary mixtures of methane and heavier hydrocarbons under conditions when both liquid and vapor phases are present together. The vapor pressure correction factor is defined by the expression:

$$c = \frac{y}{x} \cdot \frac{P}{p} \qquad \text{Equation (2b)}$$

Accurate values of p are available from a vapor pressure chart such as Diagram I. To evaluate c by the method just suggested involves, then, obtaining data on y, x and P for various conditions when two phases of binary mixtures coexist. This procedure was followed in studies of the systems methane-normal butane and methane-pentane (+) conducted in our Santa Fe Springs laboratory. Incidentally, this is analogous to the procedure followed in deriving data on which Diagram II, "Vapor Pressure Correction Factors for Propane", was based.

A. PROCEDURE.

For tests on the system methane-normal butane, one-half gallon of substantially pure normal butane (isobutane 0.12%; isopentane 0.28%) was introduced into an evacuated liquified petroleum gas cylinder having a capacity of 1.63 cubic feet. The pressure on the container was then built up to approximately 500 lbs./sq. in. absolute at a temperature of 90°F. by the addition of methane. This constituent was obtained in the pure state by passing gas from the Buttonwillow field through an absorption train including soda ash, lime, Ascarite, Dessichlora and activated charcoal. The size of the container was such that removal of each sample for fractional analysis caused a reduction of less than 1 lb./sq. in. in total pressure.

In estimating the quantity of normal butane required for the methane-normal butane test series, it was necessary to consider only losses resulting from sample removal and reductions in the total pressure on the container, using a quantity sufficient to assure the presence at all times of a liquid phase. However, pentanes(+) material is a composite of isopentane, normal pentane and heavier fractions which is subject to changes in composition when vaproization occurs. In the methane-pentanes(+) series, it was necessary, therefore, to introduce initially a quantity of pentanes(+) fractions sufficient to reduce to a practicable minimum the subsequent changes in composition. For this reason 3.5 gallons of this material separated from Kettleman Hills natural gasoline were introduced into the equilibrium bomb. This quantity is 7 times the amount of normal butane used in the proceding test series. The pressure was then raised to about 470 lbs./sq. in. absolute at 140°F. by the addition of pure methane.

To establish equilibrium between vapor and liquid phases within the container, the latter was immersed in a horizontal position in a constant-temperature water bath and rolled at frequent intervals for a period of at least 16 hours prior to removal of each set of samples for analysis. Bath temperature was controlled automatically to within ±0.1°F. during this time.

After thorough mixing of the contents of the container had been accomplished in the above manner, the equilibrium bomb was secured in a vertical position, both it and the sample withdrawal valves remaining immersed in the water bath. Simultaneous samples from the liquid and vapor phases were then expanded through these valves into small-diameter copper tubing leading to two fractionating columns. A vacuum was maintained on the sampling connections to preclude condensation ahead of the fractionating apparatus. The samples analyzed were sufficiently large to furnish a minimum of 150 c.c. of vapor (measured at standard conditions) of the component present in the smaller quantity. Samples of this size assured a high degree of accuracy in test results.

Tests were first run at different temperatures corresponding to maximum pressure on the bomb. After this series had been completed, the container and contents were cooled to about 0°F. to minimize loss of the heavier component. Sufficient vapor was then vented off to reduce the pressure 50 to 100 lb./sq. in. Tests at different temperatures were then conducted at this reduced pressure, the cycle being repeated until bomb pressure had been reduced to the order of 100 lbs./sq. in.

Properties of normal butane and pentanes(+) fractions used in the tests are given in Table I.

B. RESULTS OBTAINED.

1. VAPOR PRESSURE CORRECTION FACTORS.—Test data for the methane-normal butane series are listed in Table II, and for the methane-pentanes(+) series in Table III.

Vapor pressure correction factors were computed in accordance with Equation (2b). They are shown graphically for normal butane on Diagram IV and for pentanes(+) material on Diagram V. Diagram IV is similar to Diagram III, but with comparative data omitted.

Diagram VI is an interpretation of data included on Diagram IV in a form convenient for application to natural gasoline operations. The ranges of conditions included are pressures from 0 to 600 lbs./sq. in. absolute, and temperatures of 32°F. and from 40° to 140°F. at 10°F. intervals.

Diagram VII is an enlargement of that section of Diagram II, "Vapor Pressure Correction Factors for Propane", covering the same range of pressures and temperatures as Diagram VI.

Diagram VIII, on which are shown vapor pressure correction factors for isobutane, was derived by correlating experimental data for propane and normal butane with normal vapor pressures of all three hydrocarbons.

In the absence of experimental data on equilibrium relations for ethane, Diagram IX was derived from information published by Dr. Brown. The range of conditions covered by the chart, however, includes the critical temperature (90°F.) where it is difficult to predict the behavior of a component in a mixture. For this reason, Diagram IX is considered tentative pending further substantiation. In this connection, data on an ethane-normal heptane system are available in the April, 1938 issue of "Industrial and Engineering Chemistry", but there was inadequate time to convert the results to terms of vapor pressure correction factors for inclusion in this paper.

Vapor pressure correction factors are shown on Diagrams II to IX, inclusive, as functions of only pressure and temperature. Numerical values of correction factors are influenced also by changes in concentration of the various hydrocarbons pres-

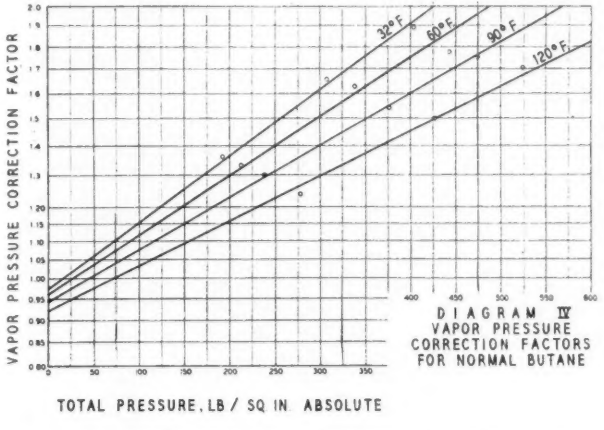
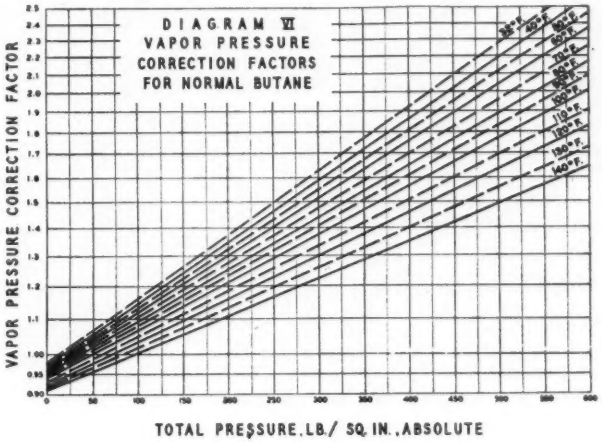


DIAGRAM IV
VAPOR PRESSURE
CORRECTION FACTORS
FOR NORMAL BUTANE



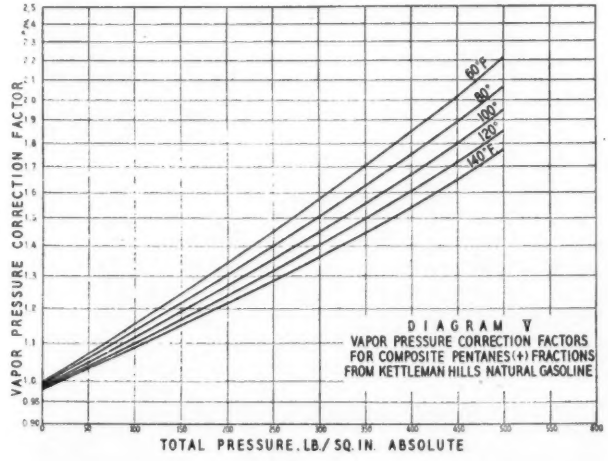
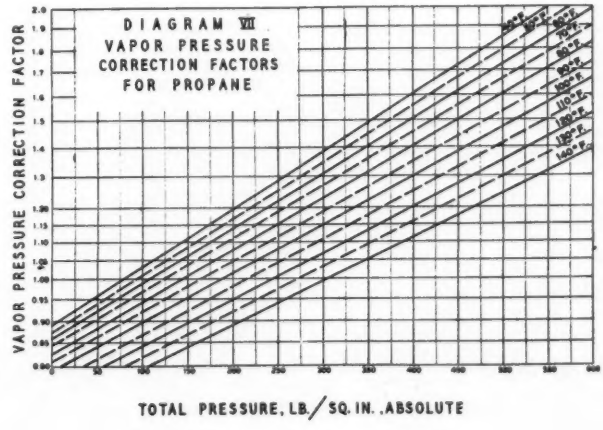
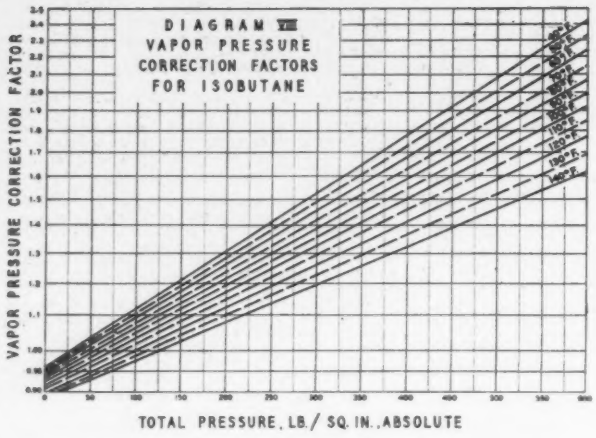


DIAGRAM V
VAPOR PRESSURE CORRECTION FACTORS
FOR COMPOSITE PENTANES(+) FRACTIONS
FROM KETTLEMAN HILLS NATURAL GASOLINE





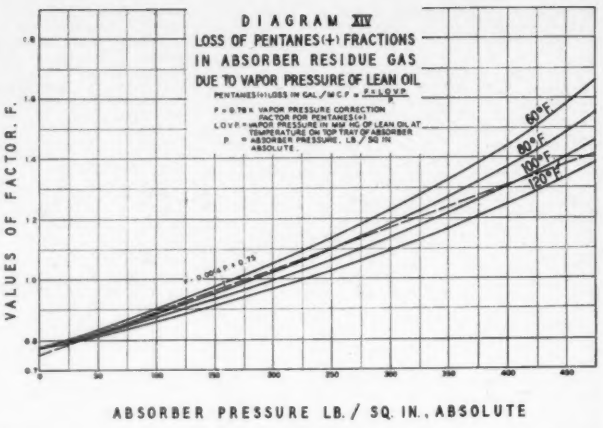


DIAGRAM XIV
LOSS OF PENTANES(+) FRACTIONS
IN ABSORBER RESIDUE GAS
DUE TO VAPOR PRESSURE OF LEAN OIL
VALUES OF FACTOR, F.
ABSORBER PRESSURE LB./ SQ. IN., ABSOLUTE

ent in a mixture. However, the charts as given are intended primarily for application in the natural gasoline industry. In the absence of exact information on the effect of concentration, it was considered satisfactory to omit this variable because the relative amounts of the heavier fractions present in the mixtures used in experimental studies, approximate those actually occurring in natural gasoline operations.

2. SOLUBILITY OF METHANE IN HYDROCARBON MIXTURES.—Even at ordinary temperatures, methane is so far above its critical temperature that it can best be considered a fixed gas in vapor-liquid equilibrium computations. It is more appropriate, therefore, to express equilibrium relations for methane in terms of its solubility in liquid hydrocarbon mixtures, rather than to attempt to derive vapor pressure correction factors for it.

Solubility is generally expressed in terms of a solubility constant, K, which may be defined as the volume of gas or vapor which will be dissolved in unit volume of solvent under a partial pressure due to the gas or vapor equal to 14.73 lb./sq. in. absolute, in accordance with the equation

$$K = \frac{\text{cu. ft. } CH_4 \text{ (measured at stand. cond.)}}{\text{cu. ft. solvent liquid (at 60°F.)}} \quad \text{Equation (3)}$$

Solubility constants for methane in normal butane and methane in pentane(+) fractions were computed in accordance with Equation (3) for the test series discussed above. The results are listed in Table IV.

All available data on solubility of methane in hydrocarbon mixtures were reviewed for the purpose of correlating them in a form convenient for practical use. A correlation with specific gravity of the methane-free solvent is shown on Diagram X. It was anticipated that the curve would be hyperbolic in form, the solubility constant having a value of infinity at the hypothetical specific gravity of liquid methane, and a value closely approaching zero for liquids in the range of high specific gravities. However, it was found that on the basis of the available information a straight-line best represented the data over the range of gravities of particular interest. Future additional data will probably permit establishing the expected curvature. Diagram XI is similar to Diagram X except that the horizontal scale is in terms of A.P.I. gravities instead of specific gravities of methane-free solvents.

Data shown on Diagram X are on a uniform basis of cubic feet of methane measured at 14.73 lbs/sq. in. absolute and 60°F., dissolved in one cubic foot of liquid measured at 60°F., under a partial pressure due to methane of one atmosphere, when the system is in equilibrium at 60°F. Solubility of a gas in liquid in general decreases with an increase in temperature. To extend application of data on Diagram X to equilibrium temperatures other than 60°F., solubility constants for methane in normal butane and in pentane(+) fractions were plotted versus temperature on Diagram XII, on the basis of determinations made at uniform partial pressures of methane equal to 400 lbs./sq. in. absolute. A satisfactory correlation between solubility constant and temperature is indicated to be represented by the relationship:

$$K_2 = K_1 \left(\frac{T_1}{T_2}\right)^{1.5}, \quad \text{Equation (3a)}$$

wherein K_1 = solubility constant at absolute temperature T_1,
and K_2 = solubility constant at absolute temperature T_2.

That is, solubility constants are inversely proportionate to the ratios of absolute temperatures raised to the 1.5 power.

III. Applications to Plant and Field Problems

A. RELATION BETWEEN ABSORBER PRESSURE AND OIL REQUIREMENTS.

Applying ordinary partial pressure—vapor pressure relationships, oil rates required to maintain a specified absorption factor are inversely proportionate to absolute absorber pressure if temperature and quality of sponge remain constant. This is in accordance with the Kremser formula:

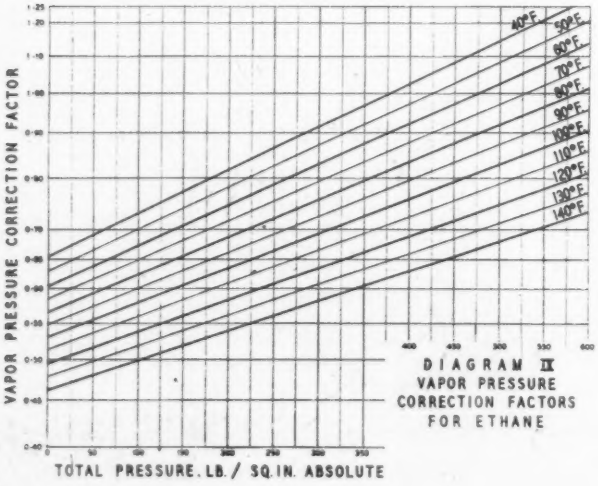
$$A = \frac{3.156\ D \cdot P \cdot G}{M \cdot p}, \quad \text{Equation (4)}$$

wherein A = absorption factor,
D and M = specific gravity and molecular weight of sponge, respectively,
P = absorber pressure, lbs./sq. in. absolute,
G = gallons sponge per MCF of gas,
and p = vapor pressure, lbs./sq. in. absolute, of constituent for which factor is computed.

Applying vapor pressure correction factors, the formula becomes:

$$A = \frac{3.156\ D \cdot P \cdot G}{M \cdot c \cdot p}. \quad \text{Equation (4a)}$$

In the preceding discussion, vapor pressure correction factors have been considered multipliers to convert the normal vapor pressure of a hydrocarbon to effective vapor pressure at different total pressures. An interpretation more convenient for application in the present problem of relating oil requirements and absorber pressure, is to consider vapor pressure correction factors a means for computing the "effective" total pressure on a system. The effective total pressure may then be defined as P/c. It will be noted that the difference between the two formulae for the absorption factor may be interpreted as the substitution in Equation (4a) of the expression P/c for the term P in Equation (4). On this basis, for constant oil-gas ratio, temperature and quality of sponge, absorption factors for a particular constituent are directly proportionate to effective absorber pressure. Conversely, oil-gas ratios required to maintain a specified absorption factor are inversely proportionate to effective absorber pressure, if temperature and quality of sponge remain constant.



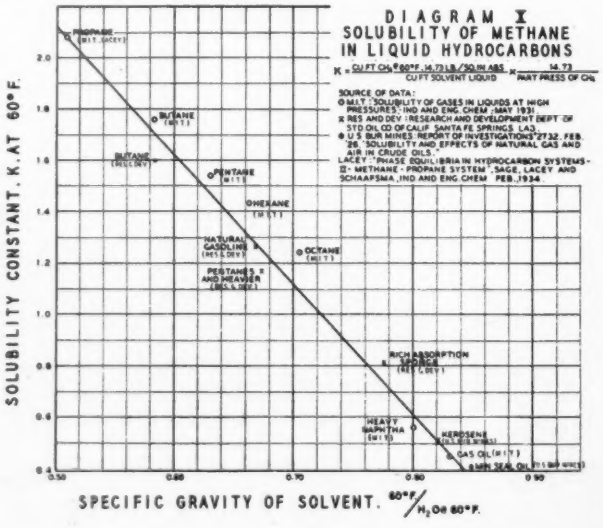
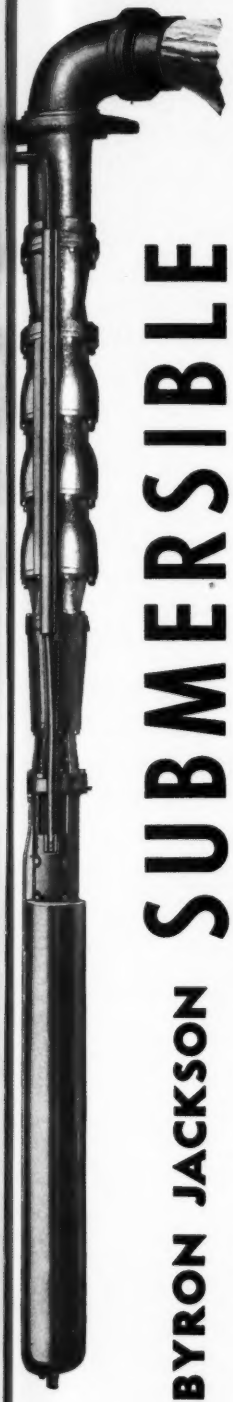


DIAGRAM I
SOLUBILITY OF METHANE
IN LIQUID HYDROCARBONS
SOLUBILITY CONSTANT, K, AT 60°F.
SPECIFIC GRAVITY OF SOLVENT, 60°F./H2O @ 60°F.

FIT THESE PUMPS INTO YOUR PICTURE



BYRON JACKSON **SUBMERSIBLE**

THE SUBMERSIBLE For LIFTING Water

The electric motor is direct-connected *below* the pump, and the entire unit is suspended by the discharge pipe and *operates submerged in the well.* The liquid pumped aids in cooling the motor, but cannot come into contact with any of the electrical parts or motor bearings as these are enclosed in a case filled with a high dielectric oil, with a mercury seal where the shaft passes through at the top.

Power is carried to the motor by a submarine armored cable. No pump house is required, the only surface equipment being a weather-proof, tamper-proof switch-box which permits control to be automatic or manual; and, since the SUBMERSIBLE requires no priming, it is ideal for remote control operation.

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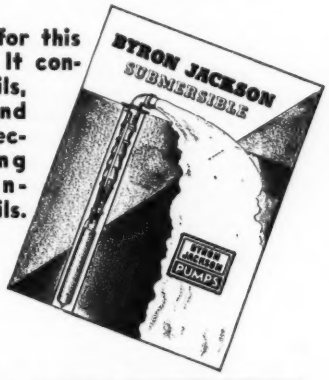

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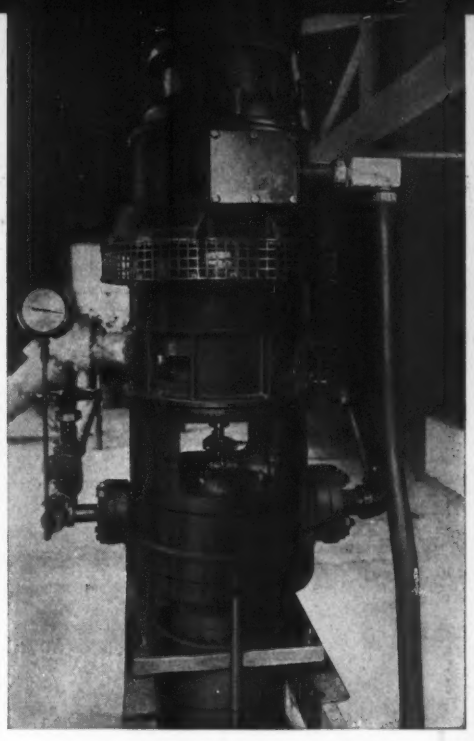

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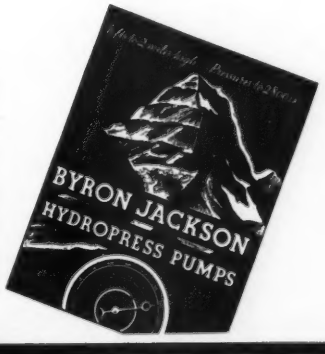

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CENTRIFUGAL PUMPS FOR EVERY SERVICE

Relations between actual and effective total pressures are shown on Diagram XIII for a wide range of operating conditions. It will be noted particularly in the case of pentanes(+) fractions that the rate of increase in effective total pressure becomes relatively low at pressures above the order of 350 lbs./sq. in. In other words, from the standpoint of reducing oil circulation requirements for extraction of pentanes(+) fractions, there is little to be gained by operating at pressures in excess of 350 lbs./sq. in. This effect is less pronounced in considering the extraction of normal butane. However, the rate of increase of effective pressure becomes quite low for this constituent at actual pressures of the order of 500 lb./sq. in.

The approximate upper limit to which gas may be compressed from pressures in the range of atmospheric in a two-stage operation is 300 lbs./sq. in. The following table includes estimates of the extent to which oil circulation requirements could be reduced by operating instead at 500 lbs./sq. in., considering extraction of both normal butane and pentanes(+) fractions, at temperatures of 60°F. and 100°F.

Constituent	Temperature	Based on ordinary part. press.-vap. press. relations	Applying Vapor Pressure Correction Factors
Pentanes(+).	60°F.	40%	15.1%
Pentanes(+).	100°F.	40	19.5
Normal Butane	60°F.	40	20.5
Normal Butane	100°F.	40	23.5

Probable actual savings in oil circulation for substantially complete pentanes(+) extraction attending an increase in operating pressure from 300 to 500 lbs./sq. in. are indicated to be less than half the gain estimated on the basis of ordinary partial pressure—vapor pressure relations. For extraction of normal butane, the corresponding reduction in oil circulation would be only slightly more than half that estimated without reference to vapor pressure correction factors. Similar application of data presented on Diagram XIII to economic analyses of proposed changes in plant operation should be of material value in selecting most favorable methods.

In deriving the relations shown on Diagram XIII, complications were avoided by neglecting the effect of changes in temperature and saturation of the sponge at different absorber pressures, because these effects are in a measure compensating. An increase in operating pressure would be attended by a higher temperature pick-up of the oil in the absorber, a condition conductive to reduced extraction efficiency. On the other hand the accompanying increase in enrichment would be favorable to a higher extraction efficiency, because the dissolved fractions themselves act as absorbents.

The curves on Diagram XIII must each be considered independently in estimating relative oil requirements for different operating conditions. To obtain a comparison between oil rates represented by corresponding points on the different curves, an additional term must be introduced, namely, the normal vapor pressure of the individual hydrocarbons. That is, for different constituents and different temperatures, actual oil requirements are a function of P/c.p instead of P/c. For example, the ratio of oil rates required to maintain the same absorption factor for normal butane and for isopentane assuming an operating temperature of 100°F. and an actual pressure of 300 lbs./sq. in., would be

$$\frac{206}{218} \times \frac{52}{25} = 2.46$$

The figures 206 and 218 are, respectively, the ratios of P/c for pentanes(+) and normal butane under the above conditions. The normal vapor pressures at 100°F. of isopentane and normal butane are, respectively, 20 and 52 lbs./sq. in. absolute.

When operation of high pressure absorbers was started at Kettleman Hills, oil circulation requirements to effect substantially complete extraction of pentanes(+) fractions were found to be appreciably higher than those indicated by application of Equation (4). That is, an absorption factor of 1.4 for isopentane which should correspond to practically complete removal of isopentane and heavier fractions from intake gas in an absorber containing 16 or more trays, was actually inadequate to reduce losses of these fractions to the desired low amount. Oil rates were increased, therefore, and operation was arbitrarily maintained at a suitable absorption factor which was well above 1.4.

The reason for this discrepancy was evident when information became available on the magnitude of departures from ordinary equilibrium relationships at pressures in the range of those carried at Kettleman Hills. Recomputing the absorption factor on the basis of Equation (4a) gave a remarkably close correlation with absorption theory.

It had been found that an oil rate of 6.5 gallons per MCF. of residue gas was necessary for satisfactory operation when absorber pressure was approximately 450 lbs./sq. in. absolute and top plate temperature was about 90°F. The oil used had a molecular weight of about 180 and specific gravity of 0.85.

The vapor pressure of isopentane at 90°F. is 16.8 lbs./sq. in. absolute. In the absence of data on vapor pressure correction factors for isopentane alone, the corresponding value for composite pentanes(+) fractions from Kettleman Hills will be used. From Diagram V, this is shown to be about 1.85. On this basis the true absorption factor for the above conditions is:

$$A = \frac{3.156 \times 0.85 \times 450 \times 6.5}{180 \times 1.85 \times 16.8} = 1.4.$$

B. LOSSES OF PENTANES(+) FRACTIONS DUE TO LEAN OIL VAPOR PRESSURE.

It is of particular importance in an analysis of absorber performance to be able to allocate observed losses of pentanes(+) fractions between (1) incomplete absorption and (2) effect of lean oil vapor pressure. This general subject was covered in the paper delivered by Mr. G. M. Liljenstein before the January, 1938, meeting of the California Natural Gasoline Association.

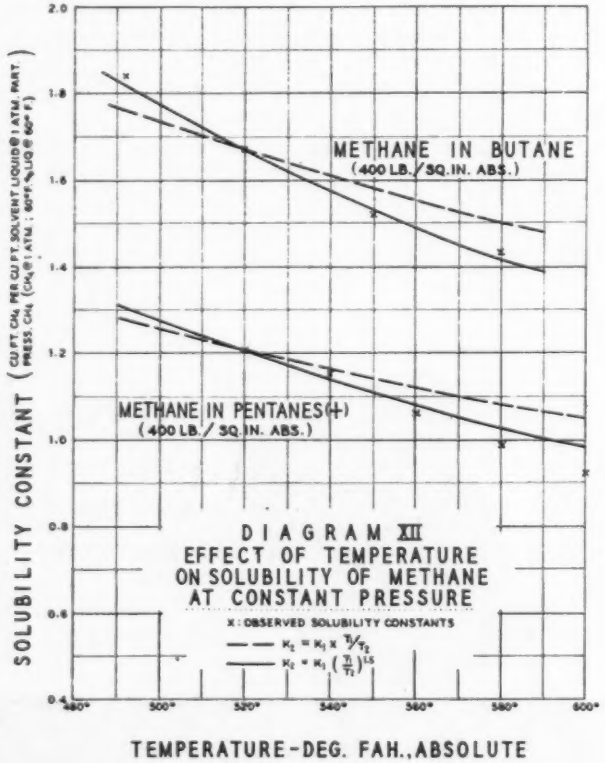
Losses due to vapor pressure of lean oil readily lend themselves to computation. It is customary, therefore, to compute these losses and to subtract them from the total observed saturations of pentanes(+) fractions in residue gas to obtain the corresponding losses due to inefficient absorption.

$$\text{Pentanes(+) in Gal./MCF.} = \frac{0.78 \times \text{L.O.V.P.}}{\text{P}}, \qquad \text{Equation (5)}$$

wherein L.O.V.P. = vapor pressure of lean oil in m.m. Hg. at temperature on top plate of absorber,
and P = absorber pressure, lbs./sq. in. absolute.

This formula is based on the assumption that the entire lean oil vapor pressure is due to pentane and heavier fractions which is the case when stripping is efficient. Its derivation was given by Mr. Alosis Kremser in his paper, on "Theoretical Analysis of the Absorption Process". The original formula included a numerical constant of 0.7, but subsequent analyses of lean oil samples have indicated the figure of 0.78 to be more nearly representative.

Lean oil vapor pressure determinations are conducted at total pressures of only substantially one atmosphere. However, losses of pentanes(+) fractions are a function of the effective vapor pres-


SOLUBILITY CONSTANT (CU FT CH4 PER CU FT SOLVENT LIQUID @ 1 ATM. PART. PRESS. CH4 (CH4 @ 1 ATM ; 60°F % LIQ @ 60° F)
METHANE IN BUTANE
(400 LB./SQ.IN. ABS.)
METHANE IN PENTANES(+)
(400 LB./SQ.IN. ABS.)
DIAGRAM XII
EFFECT OF TEMPERATURE
ON SOLUBILITY OF METHANE
AT CONSTANT PRESSURE
X: OBSERVED SOLUBILITY CONSTANTS
TEMPERATURE-DEG. FAH., ABSOLUTE

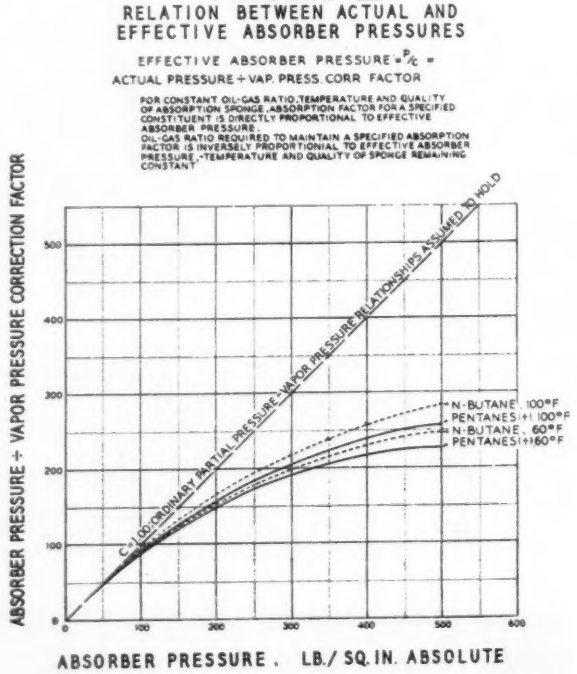


DIAGRAM XIII
RELATION BETWEEN ACTUAL AND
EFFECTIVE ABSORBER PRESSURES
EFFECTIVE ABSORBER PRESSURE = P/c =
ACTUAL PRESSURE + VAP. PRESS. CORR. FACTOR
FOR CONSTANT OIL-GAS RATIO, TEMPERATURE AND QUALITY OF ABSORPTION SPONGE, ABSORPTION FACTOR FOR A SPECIFIED CONSTITUENT IS DIRECTLY PROPORTIONAL TO EFFECTIVE ABSORBER PRESSURE.
OIL-GAS RATIO REQUIRED TO MAINTAIN A SPECIFIED ABSORPTION FACTOR IS INVERSELY PROPORTIONAL TO EFFECTIVE ABSORBER PRESSURE, -TEMPERATURE AND QUALITY OF SPONGE REMAINING CONSTANT
ABSORBER PRESSURE ÷ VAPOR PRESSURE CORRECTION FACTOR
C = 100 ORDINARY PARTIAL PRESSURE - VAPOR PRESSURE RELATIONSHIPS ASSUMED TO HOLD
N-BUTANE, 100°F
PENTANES (+) 100°F
N-BUTANE, 60°F
PENTANES (+) 60°F
ABSORBER PRESSURE, LB./SQ.IN. ABSOLUTE

sure of the lean oil at absorber operating pressure, which is equal to the product of the determined vapor pressure times the corresponding vapor pressure correction factor for pentanes(+) fractions. By combining the constant, 0.78, in Equation (5) and the vapor pressure correction factor, the following expression is obtained:

$$\text{Pentanes(+) loss in Gal./MCF.} = \frac{F \times \text{L.O.V.P.}}{P}, \qquad \text{Equation (5a)}$$

wherein F = 0.78 x vapor pressure correction factor.

Values of F are shown graphically on Diagram XIV for the range of temperatures and pressures likely to be encountered in absorption operation. The straight dashed line is an approximate average relationship sufficiently accurate for field testing purposes. It is represented by the equation:

$$F = 0.0014\ P + 0.75 \qquad \text{Equation (6)}$$

Substituting this expression in Equation (5a), the following convenient formula for field use is obtained:

Pentanes (+) loss in Gals./MCF. =

$$(0.0014 \times \text{LOVP}) + \frac{0.75 \times \text{L.O.V.P.}}{\text{Absolute Absorber Pressure}} \qquad \text{Equation (5b)}$$

The term, 0.0014 x L.O.V.P., in Equation (5b) represents the effect of departures from ordinary equilibrium relationships. At pressures of 50 lbs./sq. in. or below, the numerical value of this term comprises only a negligible proportion of the total pentanes(+) losses. However, at absorber pressures of the order of 400 lbs./sq. in., this term accounts for about 40% of the total loss due to lean oil vapor pressure.

C. CONDENSATION IN COMPRESSION SYSTEMS.

Computations of the extent of condensation effected by compression and subsequent cooling of wet gases and plant vapors are of fundamental importance in deriving materials balances for plant systems. Moreover, they are particularly applicable involving production of liquefied petroleum gases where the larger part of the yield is obtained by condensation from vapors rich in fractions comprising these products.

For the purpose of illustrating the large difference in results of computations of vapor-liquid equilibria at high pressures when ordinary partial pressure—vapor pressure relations are applied and when vapor pressure correction factors are introduced, volumes and compositions of condensate and residue vapors which would result from cooling to 90°F. the high pressure discharge gas from a booster unit at Kettleman Hills, are given below for both methods of computation. The results shown are on the basis of 1,000 MCF (measured at standard conditions) of uncooled gas at a pressure of 450 lbs. per sq. in. absolute and having a composition of about 65% methane, 12-13% each of ethane and propane, 7% butanes, and 3% pentanes(+) fractions.

1. Quantity and Composition of Condensate.

	Partial Pressure-Vapor Pressure Method	Method Using V.P. Correction Factors
Ethane	218 Gal.	135 Gal.
Propane	857 Gal.	353 Gal.
Isobutane ...	304 Gal.	138 Gal.
N-butane	891 Gal.	422 Gal.
Pentanes(+) .	989 Gal.	700 Gal.
Total	3,259 Gal.	1,748 Gal.
Dissolved Methane,	14.5 MCF	7.8 MCF

The volume of condensate indicated by ordinary partial pressure—vapor pressure computations is 1.86 times as large as that which would be predicted from the more reliable method of computation. Moreover, it is shown that whereas on the basis of customary methods of computation approximately 85% of the available pentanes(+) fractions would be expected to condense, condensation of this material would probably be instead actually only 60% complete.

2. Quantity and Composition of Residue Vapors.

For each 1,000 MCF of gas cooled to 90°F., there would result the following volumes of residue vapors:

	Partial Pressure-Vapor Pressure Method	Method Using V.P. Correction Factors
Methane	631.6 MCF	638.3 MCF
Ethane	112.6 MCF	116.2 MCF
Propane	97.9 MCF	116.3 MCF
Isobutane	11.1 MCF	16.3 MCF
N-butane	23.7 MCF	38.6 MCF
Pentanes(+) .	4.6 MCF	12.1 MCF
Total	881.5 MCF	937.8 MCF

The amount of pentanes(+) material in the residue vapors would be 2.6 times that which would be expected from ordinary partial pressure—vapor pressure relations.

3. Dew Point.

The dew point of the uncooled gas would be 122°F. Using ordinary partial—vapor pressure relations, the corresponding temperatures at which condensation would be expected to commence at a pressure of 450 lbs./ sq. in. absolute would be 152°F. This temperature is 30°F. higher than the corresponding dew point computed by the more reliable method using vapor pressure correction factors.

IV. Conclusions.

A. APPLICATION OF VAPOR PRESSURE CORRECTION FACTORS.

Departures from ordinary partial pressure— vapor pressure relationships exhibited by paraffin hydrocarbons are of sufficient magnitude to justify their consideration in all computations involving these materials at ordinary temperatures when pressure is in excess of 100 lbs./sq. in. This can be readily accomplished simply by introducing into conventional methods of computation a term designated as the vapor pressure correction factor.

B. RELATION BETWEEN ABSORBER PRESSURE AND LEAN OIL REQUIREMENTS.

On the basis of ordinary equilibrium relations, oil circulation required to maintain a specified absorption factor is inversely proportionate to absolute absorber pressure, other conditions remaining the same. However, when departures from these relations are taken into consideration, it is shown that possible reductions in oil rate attending increase in operating pressure are appreciably less. For extraction of pentanes(+) fractions, there is substantially no gain accruing to operation at pressures above 350 lbs./sq. in.

It is probable that when gas available at pressures in the range of atmospheric is to be delivered to sales lines at a pressure of the order of 500 lbs./sq. in., the most favorable procedure would be to conduct the absorption step at the upper limit of two-stage compression (i.e., about 300 lbs./sq. in.), subsequently boosting dry gas to the required line pressure. In this manner less expensive absorption equipment could be used, and in the final compression operation advantage could be taken of the shrinkage in gas volume attending the absorption step.

C. PENTANES(+) LOSSES DUE TO LEAN OIL VAPOR PRESSURE.

Departures from ordinary equilibrium relations are reflected in relatively larger losses of pentanes(+) fractions resulting from lean oil vapor pressure than would be expected in accordance with conventional methods of computation. A simple formula has been developed for accurately evaluating these losses. It is shown that in the range of high pressure absorber operation at Kettleman Hills the portion of total pentanes(+) losses assessable against incomplete stripping of the lean oil may be as much as twice that previously attributed to this source under similar conditions. A more reliable allocation of pentanes(+) losses is of importance not only in analyzing absorber performance, but also in establishing the proper balance between stripper and absorber operation.

D. FURTHER WORK.

Charts of vapor pressure correction factors included in this paper are of a preliminary nature only. In particular, data are lacking on the effect of concentration of a constituent of a hydrocarbon mixture upon the numerical value of its vapor pressure correction factor at given conditions of temperature and pressure. Experimental investigations from which additional data on correction factors may be derived are in progress in various industrial and academic research laboratories. Analysis and correlation of the results obtained should ultimately lead to the development of highly reliable basic data covering the range of conditions of interest in the natural gasoline industry. This correlation might well be undertaken by a group in the California Natural Gasoline Association such as Committee No. 5 on Physical Constants.

In closing, I wish to express my appreciation for the cooperation of those who have aided in developing the information presented in this paper, particularly to Mr. Alois Kremser for his many helpful suggestions, and to Messrs. W. C. Dayhuff and W. M. Schaufelberger, who were entirely responsible for the experimental work discussed.

TABLE I

PROPERTIES OF LIQUIDS USED IN EQUILIBRIUM TESTS

A. NORMAL BUTANE

1. Fractional Analysis:

Isobutane.....	0.12%
N-butane.....	99.59
Isopentane (+)..	0.29
	100.00%

2. Vapor Pressure:

Temperature °F.	Vapor Pressure—Lbs./Sq. In. Abs.		
	Computed	D., J., B., T.*	Bomb Pressure**
32	14.8	14.8	15.6
60	26.3	26.3	26.8
90	44.5	44.5	44.4
120	70.7	70.8	69.1

*—Dana, Jenkins, Burdick & Timm, "Refrigerating Engineering", Vol. 12, P. 387, seq., (1926).
**—Pressure readings on the sample bomb were used as a check on the handling procedure. Data for pure normal butane were used in equilibrium calculations.

B. PENTANES (+) MATERIAL.

1. Fractional Analysis:

Isopentane.....	29.92%
N-pentane.....	18.21
Hexanes (+).....	51.87
	100.00%

2. Gravity of Pentanes (+): 78.5° A.P.I.; of Hexanes (+): 65.9° A.P.I.

3. Vapor Pressure:
Reid Vapor Pressure of Pentanes (+): 10.5 lbs./sq. in.

Equilibrium Vapor Pressure

Temperature °F.	Vapor Pressure—Lbs./Sq. In. Abs.	
	Vapor / Liquid Ratio = 0.1	*Vapor / Liquid Ratio = 1.5-3.0
60	5.85	5.20
80	8.60	7.80
100	12.20	11.40
120	17.05	16.35
140	23.60	22.45
160	31.60	30.55

*—Used in equilibrium calculations. Actual ratio in bomb approximately 2.5.

TABLE II

TEST DATA FOR METHANE—NORMAL BUTANE SYSTEM

Test No.	Temperature °F (T)	V.P. N-Butane Lb./Sq. In.Abs. (p)	Total Pressure Lb./Sq. In.Abs. (P)	Mol % N-Butane In Vapor (y)	Mol % N-Butane In Liquid (x)	V.P. Correct Factor y P / x p
17	120.0	70.8	523.7	19.42	84.50	1.70
18	120.0	70.8	425.8	21.95	87.97	1.50
24	120.0	70.8	276.6	29.41	93.06	1.24
16	90.0	44.5	474.0	14.04	84.70	1.765
19	90.0	44.5	377.6	15.96	87.99	1.54
25	90.0	44.5	238.0	22.55	92.81	1.30
11	59.9	26.1	440.6	8.89	84.60	1.774
20	60.0	26.3	338.2	11.06	87.64	1.625
23	60.0	26.3	211.9	15.24	92.54	1.327
12	32.2	14.9	402.8	5.91	84.67	1.89
13	32.8	15.0	401.8	5.90	84.13	1.88
21	32.2	14.9	306.7	6.99	87.42	1.65
22	32.2	14.9	192.2	9.71	92.23	1.36

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TABLE III

TEST DATA FOR METHANE—PENTANES (+) SYSTEM

Test No.	Temperature °F (T)	V.P. Pentanes (+) Lb./Sq. In.Abs. (p)	Total Pressure Lb./Sq. In.Abs. (P)	Mol % Pentanes (+) In Vapor (y)	Mol % Pentanes (+) In Liquid (x)	V.P. Correct Factor $c = \frac{y}{x} \cdot \frac{P}{p}$
2	140.0	22.45	467.4	7.23	87.83	1.71
3	140.0	22.45	465.2	7.15	87.14	1.70
5	140.0	22.45	457.4	7.08	86.85	1.66
1	140.0	22.45	372.4	8.23	89.49	1.525
15	140.0	22.45	153.8	16.16	96.33	1.15
6	120.0	16.35	428.9	5.53	87.53	1.655
13	120.0	16.35	310.7	6.82	91.00	1.425
14	120.0	16.35	307.6	6.82	91.14	1.406
16	119.8	16.19	126.3	13.34	96.79	1.08
4	100.0	11.40	414.4	4.45	86.35	1.90
9	100.0	11.40	386.7	4.34	87.70	1.68
18	100.0	11.40	107.3	11.26	97.05	1.09
7	60.0	5.20	354.4	2.18	87.17	1.705
12	60.0	5.20	266.4	2.62	90.55	1.48
19	60.0	5.20	86.0	6.24	96.67	1.067

TABLE IV

SOLUBILITY CONSTANTS FOR METHANE COMPUTED FROM EQUILIBRIUM TEST DATA

A. IN NORMAL BUTANE*

Pressure Lbs/Sq.In. Absolute	TEMPERATURE (T) 32°F.	60°F.	90°F.	120°F.
	K expressed as cu.ft. Gas at Std. Cond/cu.ft. Liquid at 60°F.			
500	....	....	1.59	1.50
400	1.84	1.67	1.52	1.43
300	1.76	1.61	1.47	....
200	1.67	1.53	....	....
100	1.56	....	....	....

*—A.P.I. Gravity 110.5°; Equivalent Volume 31.8 Cu.Ft./Gal.

B. IN PENTANES (+)**

Pressure Lbs/Sq.In. Absolute	TEMPERATURE (T) 60°F.	80°F.	100°F.	120°F.	140°F.
	K expressed as cu.ft. Gas at Std. Cond/cu.ft. Liquid at 60°F.				
500	1.27	1.200	1.103	1.013	0.958
400	1.21	1.157	1.063	0.990	0.922
300	1.17	1.098	1.037	0.960	0.887
200	1.12	1.055	0.994	0.928	0.865
100	1.075	1.021	0.957	0.901	.....

**—A.P.I. Gravity 78.5°; Equivalent Volume 25.6 Cu.Ft./Gal.

APPENDIX I

RELATION BETWEEN FUGACITY AND VAPOR PRESSURE CORRECTION FACTOR

In most current literature on properties of paraffin hydrocarbons, equilibrium relations are expressed in terms of fugacity, and corresponding charts are given on which are shown the ratios of fugacity to total pressure, f/P, for various conditions of temperature and pressure. It will be useful, therefore, to present the relation between vapor pressure correction factor and f/P in such manner that vapor pressure correction factors may be computed readily from corresponding published values of f/P.

An equation for representing equilibrium between a liquid and a gaseous phase expresses the fact that this condition is attained when the "escaping tendency" of a component in the liquid becomes equal to its "escaping tendency" in the vapor. If the vapor from a substance behaved as an ideal gas, the product of its normal vapor pressure times its mol fraction in the liquid phase would represent its tendency to escape from the liquid phase, in accordance with Raoult's Law; and the product of its mol fraction in the gas or vapor phase times the total pressure on the system would represent the corresponding tendency to escape from the gas phase, in accordance with Dalton's Law. This relationship is given by Equation (1) in the body of the report.

However, as stated previously, this equation is even approximately true over only a relatively limited range of pressures. It was for this reason that the expression "fugacity" was introduced to represent the true measure of the escaping tendency of a component from a phase: Using this concept, equilibrium conditions are represented as follows.:

$$\left(f_L\right)_P \cdot x = \left(f_V\right)_P \cdot y, \qquad \text{Equation (7)}$$

Wherein $\left(f_L\right)_P$ = fugacity of the component under consideration, in the liquid phase under the total pressure P;

x = mol fraction of the component in the liquid phase;

$\left(f_V\right)_P$ = fugacity of the component under consideration, in the vapor phase under the total pressure P;

and y = mol fraction of the component in the gas phase.

By combining the above equation with Equation (2) presented in the body of the report, the following relation is obtained, which may be considered the formal definition of the vapor pressure correction factor:

$$c = \frac{\left(f_L\right)_P}{\left(f_V\right)_P} \cdot \frac{P}{p} \qquad \text{Equation (8)}$$

Lewis and Randall in "Thermodynamics" have developed an equation equivalent to:

$$RT \ln \frac{\left(f_L\right)_P}{\left(f_L\right)_p} = V\,(P - p) \qquad \text{Equation (9)}$$

Wherein R = gas constant = 10.71 when pressure-volume-temperature relations are expressed in terms of lbs./sq. in. absolute - cubic feet - degrees Fahrenheit absolute;

T = temperature of the system;

$\ln \frac{\left(f_L\right)_P}{\left(f_L\right)_p}$ = logarithm to the base "e" of the ratio of the fugacity of the liquid at total pressure, P, to its fugacity under its own vapor pressure, p;

and V = molecular volume of the liquid, expressed as cubic feet/pound mol. (For practical purposes this may be considered constant for a particular liquid).

Equation (9) may be written as follows:

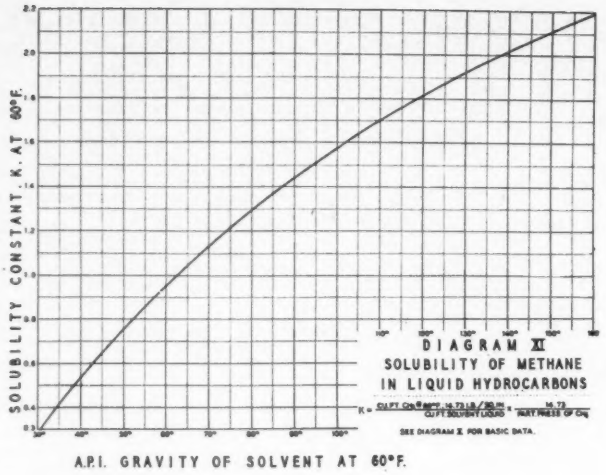
$$\frac{\left(f_L\right)_P}{\left(f_L\right)_p} = e^{\frac{V}{RT}(P - p)} \qquad \text{Equation (10)}$$

The following equality is fundamental:

$$\left(f_L\right)_p = \left(f_V\right)_p \qquad \text{Equation (11)}$$

It expresses the fact that for equilibrium conditions, the escaping tendency of a component in the liquid phase is equal to that of its vapor. Substituting $\left(f_V\right)_p$ for $\left(f_L\right)_p$ in Equation (10), and transposing, the following relation results:

$$\left(f_L\right)_P = \left(f_V\right)_p \cdot e^{\frac{V}{RT}(P - p)} \qquad \text{Equation (12)}$$


SOLUBILITY CONSTANT, K, AT 60°F.
A.P.I. GRAVITY OF SOLVENT AT 60°F.
DIAGRAM XI
SOLUBILITY OF METHANE
IN LIQUID HYDROCARBONS
SEE DIAGRAM X FOR BASIC DATA.

Substituting in Equation (8), this value for $\left(f_L\right)_P$:

$$c = \frac{\left(f_V\right)_p \cdot e^{\frac{V}{RT}(P - p)}}{\left(f_V\right)_P} \cdot \frac{P}{p} \qquad \text{Equation (13)}$$

$$\text{or } c = \left(\frac{\left(f_V\right)_p}{p} \Big/ \frac{\left(f_V\right)_P}{P}\right) \cdot e^{\frac{V}{RT}(P - p)} \qquad \text{Equation (13a)}$$

Equation (13a) expresses the fact that the vapor pressure correction factor is the ratio of fugacity/pressure at pressure p, to fugacity/pressure at pressure P, multiplied by the expression, $e^{\frac{V}{RT}(P-p)}$. The latter expression takes into account the effect on vapor pressure correction factor introduced by changes of fugacity of components in the liquid phase.

In a recent paper on "Fugacity of Various Hydrocarbons Above Their Vapor Pressure and Below Critical Temperature", by W. K. Lewis and W. C. Kay, published in the "Oil and Gas Journal" for March 29, 1934, the statement is made that changes in the value of the fugacity of a hydrocarbon in the liquid phase are "in most cases small relative to the tremendous variations" in the fugacity of the hydrocarbon in the vapor phase. "Tentatively, therefore, it is suggested to ascribe to the term f'_p (equivalent to $\left(f_L\right)_P$ in the above equations) "its value for the pure liquid component at the temperature in question, uncorrected for other influences".

The above proposal is equivalent to considering as $e^{\frac{V}{RT}(P-p)}$ 1.0 the term $e^{\frac{V}{RT}(P-p)}$, given in Equation (13a). An approximation of the vapor pressure correction factor, c, becomes therefore, simply:

$$c = \frac{\left(f_V\right)_p}{p} \div \frac{\left(f_V\right)_P}{P} \qquad \text{Equation (13b)}$$

Equation (13b) was used in deriving the vapor pressure correction factors attributed to W. K. Lewis on Dingram III. Had Equation (13a) been used, the discrepancy would have been even greater between his data and corresponding results for normal butane obtained in the Santa Fe Springs Laboratory.

Refining Industry Cannot Mark Time

Operators Must Keep Their Plants Modern Or Lose To More Progressive

The nation's biggest taxpayer, petroleum refining, is also the nation's best customer. However slender the margin of profit that may be left to the refiner after payment of nearly 200 taxes, he cannot cease building because his is a business in which depreciation and obsolescence speedily overtake the penny wise. While the condition of business at present is regarded as unfavorable, California refiners are spending between ten and fifteen millions of dollars in current expansion and rehabilitation programs at their plants.

In 1937 the number of refineries in California increased from 77 to 82, with straightrun capacity advancing from 858,110 bbls. daily to 897,320 bbls. daily, and cracked gasoline production capacity moving up from 94,320 bbls. daily to 98,720 bbls. daily. The number of operating plants increased from 59 to 68, and their crude oil capacity increased from 786,860 bbls. daily to 818,610 bbls. daily. With minor repairs straightrun equipment with 49,000 bbls. daily capacity would become operative, while major repairs would be required to put into operation additional equipment with 30,050 bbls. daily capacity. Cracking equipment with capacity to produce 12,600 bbls. daily of gasoline could be made operative with minor repairs, while additional production of 3,400 bbls. daily of cracked gasoline is possible with major repairs.

In 1938 refinery equipment under construction has a straightrun capacity in excess of 80,000 bbls. daily, while new cracking equipment will produce close to 20,000 bbls. daily of gasoline.

The largest refinery construction project now under way is that of the Richfield Oil Corp., which is building a $5,000,000 refinery at Watson. Principal activity to date centers around the erection of the eight furnaces to be used with the two modern combination crude topping and cracking units to be installed. Standing 132 feet high and having a diameter of 30 feet, the six DeFlorez heaters are the largest ever to be erected on the Pacific Coast. Cost of the heaters and their auxiliary equipment will be about $1,000,000.

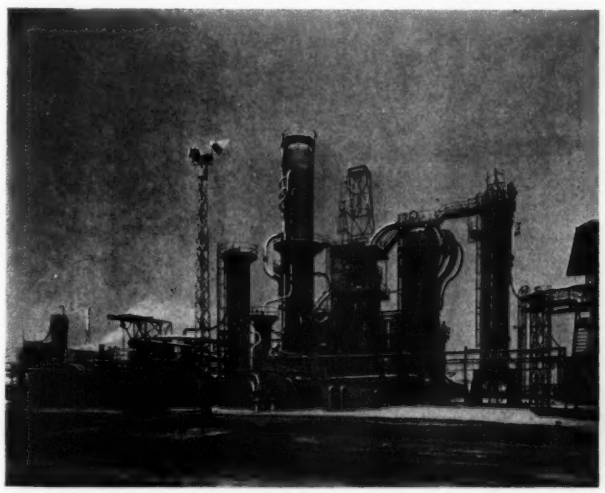
When completed, each of the heaters will contain roughly one and one-half miles of 51-in. alloy tubing. Each of the combination units will have a battery of four heaters, three of the DeFlorez vertical down fired type and one of the Alcorn double fired horizontal tube type. This group of furnaces is designed to liberate 300,000,000 heat units an hour. Capacity of the heaters is 25,000 bbls. daily per combination unit. Maximum uniform temperature obtainable in the furnaces is estimated at 1500° F.

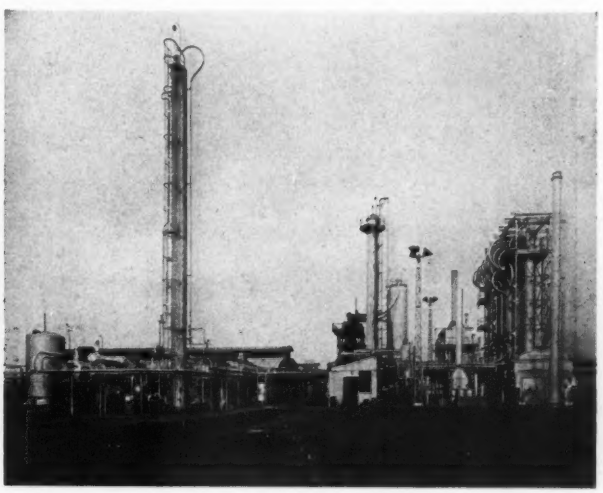
Crude oil entering either of the combination units will first be pumped through a system of heat exchangers where its temperature will be raised by hot streams from the fractionating towers. From the exchangers the oil will pass to the Alcorn heaters. One side of the Alcorn heaters will be used for crude while the other is used for reduced crude returning from the flash towers. Each side of the heater will consist of a radiant heating section surrounded by carbon steel tubes. Gases from both sides will discharge into a common down draft convection section where they will pass around the convection tubes. The crudes entering the furnace will pass upward through a bank of convection tubes into the radiant section tubes. The heat transmitted to the crude in the furnace will vary from 3,500,000 to 20,000,000 B.t.u. per hour, depending upon the cleanliness of the heat exchangers.

When the heat exchangers become dirty, the furnace fuel consumption will increase, but the outlet temperature will be automatically regulated at 625°. At this temperature the crude will pass to the flash towers where the straightrun gasoline will be removed. Reduced crude returns from the flash towers to the Alcorn furnace and enters the constant load side through a bank of convection tubes. In this side of the furnace 25,000,000 B.t.u. per hour will be transmitted to the charge and the outlet temperature of the reduced crude will be built up to 670° F.

A uniform temperature of about 1,000° F. will be maintained in the DeFlorez heaters to induce cracking. Use of the three large vertical heaters in each cracking plant will permit practically any recycling ratio which may be desired. There will be seven separating and frac-

Left, Dubbs installation at Wilshire refinery showing from left to right, crude fractionating tower, main fractionator, stripping column, flash chamber and reaction chamber. Right, polymerization plant at Wilshire. Polymerization plant furnace at left center; five catalyst towers at right, and hydrogen sulphide removal unit at left.





tionating towers for each combination unit. The largest of these will be roughly 13 feet in diameter and 60 feet high, weighing approximately 270,000 pounds.

Wilshire Oil Co., Inc., is installing a Dubbs reforming unit with a rated charging capacity of 4000 bbls. of naphtha a day. The unit will be operated under license from Universal Oil Products Co., of Chicago. The Wilshire company is also adding a crude heater to its existing Dubbs simultaneous skimming and cracking unit, designed to handle 18,000 bbls. of crude a day. The addition of this heater will enable the topping and reforming sections to be operated independently of the cracking unit.

Installation of these two units marks another step in a progressive refinery planning and construction program that already has put Wilshire in a leading position among American refiners in efficiency and economy of operation as well as in yield and quality of gasoline produced. The operation of the new reforming unit and crude heater will mesh with those of the Dubbs combination 2-coil selective cracking unit and the U.O.P. catalytic polymerization unit previously installed. The three Universal processes will work together to increase the overall capacity of the refinery and raise still further the average octane number of the several grades of gasoline produced.

Union Oil Co.'s crude unit at Oleum. View showing the atmospheric and vacuum cooler.

Inside Wilshire's steam generating plant

The Wilshire refinery construction program at its Norwalk refinery started more than three years ago on a bare field in the heart of the Santa Fe Springs field. Foresight of Wilshire executives had led them to store fuel oil resulting from previous skimming operations at Vernon until there were several million barrels in storage when they decided to build a refinery to convert it into motor fuel.

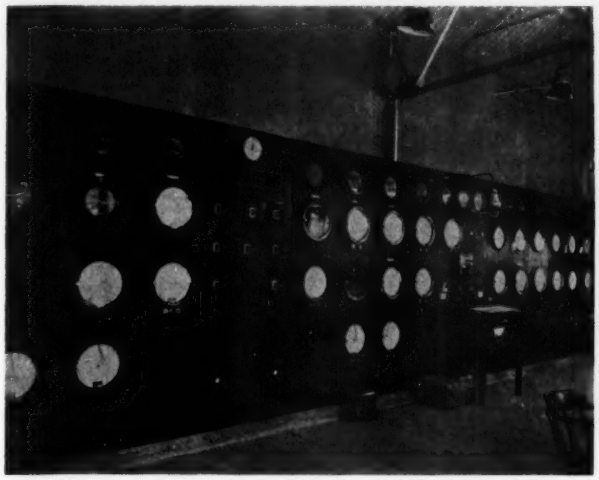
In 1935 Wilshire signed a license contract for a Dubbs simultaneous topping and cracking unit and on June 23, 1936, it went into operation. From the start it exceeded expectations. When topping 18,000 bbls. a day, about 2000 bbls. of straightrun gasoline of 250° endpoint is produced, 4000 bbls. of naphtha of 450-470° endpoint, and 12,000 bbls. of topped crude for the cracking unit. The naphtha will be charged to the new reforming unit. Late in 1936, Wilshire signed a license agreement for a catalytic polymerization unit to process 2,500,000 cu. ft. of gas a day. It went into operation in July, 1937. Its product blended with gasoline produced in the cracking unit, is marketed as a special high octane premium motor fuel under the name "Polly Gas".

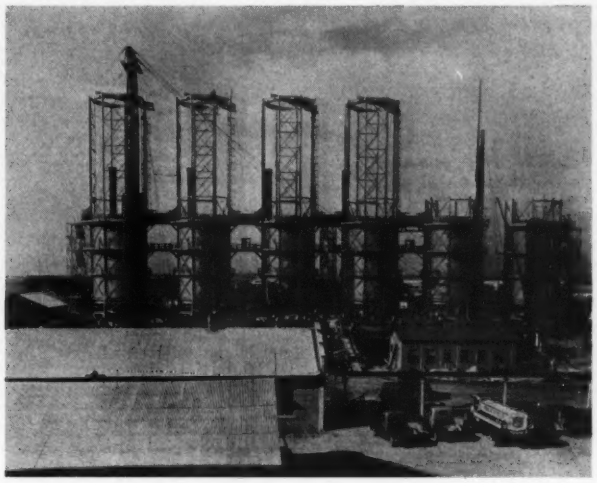
The yield of polymer gasoline will be considerably increased when the new reforming unit is in operation, because more gas will be produced as charge for the catalytic polymerization unit.

Union Oil Co. of California has been making extensive additions and alterations to its two main refineries at Wilmington and Oleum. At Oleum the erection of a new unit for cracking heavy oils was begun on July 1, 1937. This plant, which is just commencing operations, is one of the largest of its kind on the Pacific Coast, having a daily yield of about 4000 bbls. of finished cracked gasoline. It was designed by Union Oil Co. engineers. Among the essential items in the plant is one of the largest pressure vessels ever manufactured, and the largest ever to be shipped to the West.

Supplementing the cracking unit was a pressure distillate treating and rerunning

Left, Polymer plant meter panel in control house at the Richmond refinery of Standard Oil Co. of California. Right, the six DeFlorez heaters going up for Richfield Oil Corp.'s $5,000,000 refinery at Watson. These furnaces stand 132 ft. high and are the largest ever built on the Pacific Coast.





plant which was built coincidentally with the former to provide adequate facilities for acid treatment and redistillation of the cracked gasoline. It was also found necessary to furnish additional circulating salt water in order to meet the immediate needs of the enlarged system and to assure an adequate future supply.

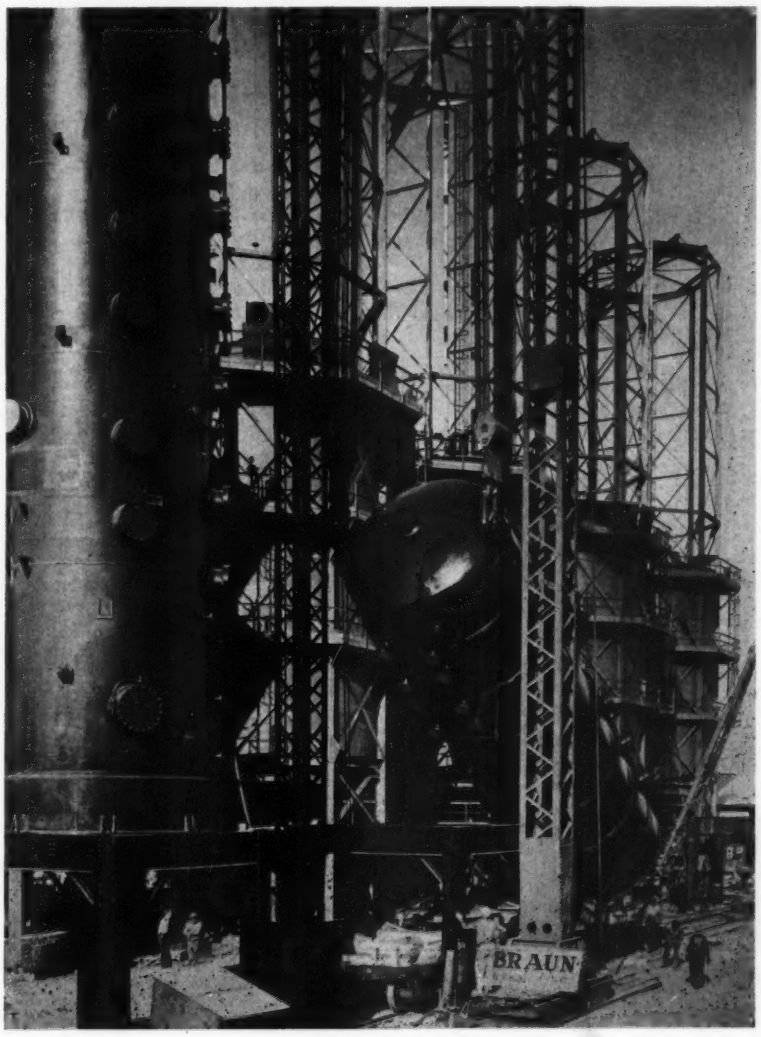
A new crude distillation unit was constructed at Oleum during the year to replace a 10,000-bbl. per day battery of shell stills, increase the thoroughput to 15,000 bbls., and thoroughly rejuvenate the system. These developments raised the power and steam requirements of the refinery and made necessary the replacement of many steam-driven pumps and engines with electrically driven machinery.

A major item in the Los Angeles refinery program was the rearrangement of air-blown asphalt facilities and the enlargement of the asphalt plant in order to further improve the quality of the product and double the production. Pumps, air compressors, condensers, storage tanks, and five G-A stills were added to existing equipment. In addition, new heaters, fractionating columns, condensers, coolers, pumps, and lines were installed to increase the output of many industrial specialties manufactured.

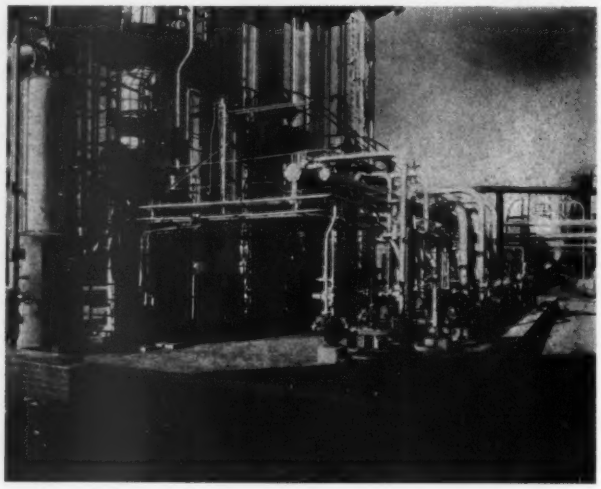
With these and other incidental changes, Union Oil Co.'s refineries have been thoroughly modernized and are adequate to take care of an extensive program of operation for some years to come.

Standard Oil Co. of California's current construction program at the Richmond refinery will probably involve total expenditures in excess of $2,000,000 in equipment alone. Already on stream is the new $600,000 polymerization plant, and work will be completed this year on

135,000-lb. vacuum evaporator being hoisted into place along side of crude tower and DeFlorez furnaces at Richfield Oil Corp.'s new refinery at Watson.



Left, pouring concrete for control room and pump house for Richfield's new refinery at Watson, with one of the new absorbers in the background. Right, view of a portion of the Standard Oil Co. of California's polymerization plant.



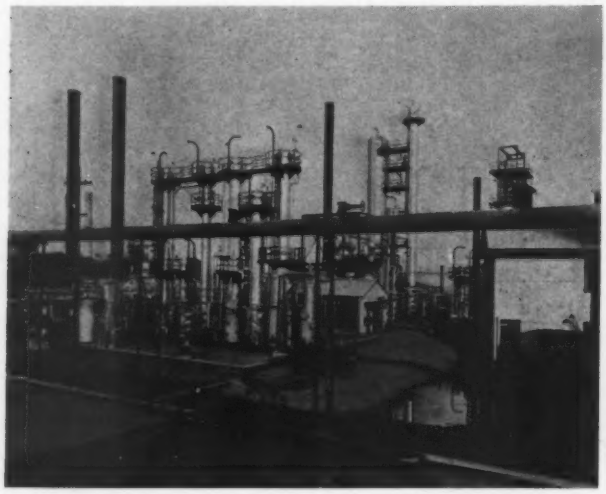
a hydrogenation plant costing over $1,000,000, and a complete new lubricating oil plant the cost of which has not been announced yet.

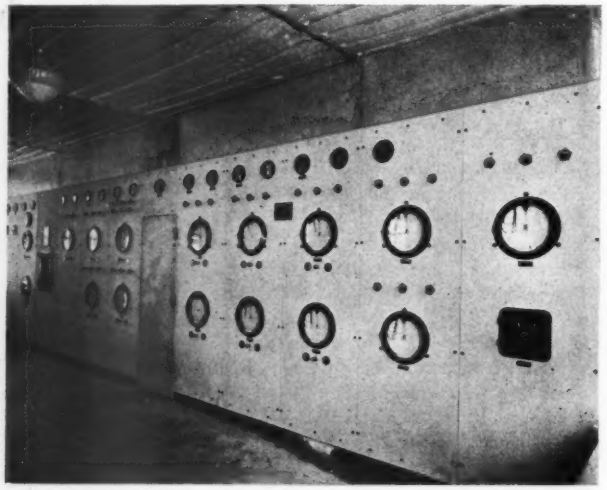
The polymerization and hydrogenation installations provide the Standard company with facilities for making gasoline of 100 or more octane, suitable for new uses where maximum power and performance are required. The raw material used in manufacturing gasoline by the polymerization process is the olefin gas formed as a by-product in the company's cracking process. While three olefins are present in the fixed gas from the cracking units, only one, butene, is particularly suited to the manufacture of polymer gasoline. The first steps in the process, therefore, company engineers explain, have for their objectives the separation of butene from all other constituents of the gas which would either interfere with the final conversion into polymer gasoline or would detract from the quality of the finished product. A major portion of the equipment shown in the accompanying illustrations was built solely for these separation and purification steps.

The purified butene is pumped to reaction vessels where the actual conversion to polymer gasoline takes place. In the reaction vessels is a special catalyst, developed in the company's own laboratories, which speeds up the conversion rate many thousands of times. Control of the reaction to give the exact product desired is accomplished by many unique features in engineering designs. For example, it is pointed out, temperature, pressure, and reaction time may each be varied independently to keep in close step with variations in quality of the butene feed available, with variations in activity of the reaction catalyst, and with variations in the particular type of product desired.

The company's engineers point out that polymer gasoline is composed entirely of olefinic hydrocarbons, a property which makes it an ideal raw material for synthesis of numerous chemical by-products, interesting applications being noted in the paint, paper, soap, plastics, rubber and other industries. It is in the manufacture of high octane aviation motor fuel that polymerization has its most important use at present. For this purpose the olefinic product has to be hydrogenated by a catalytic process, involving operation at high pressures and temperatures. A plant costing over a million dollars for carrying out this further step is nearing completion at the Richmond refinery.

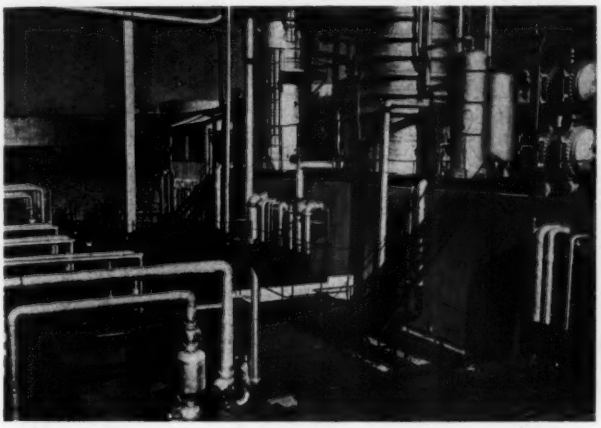
Checking over current refinery con-

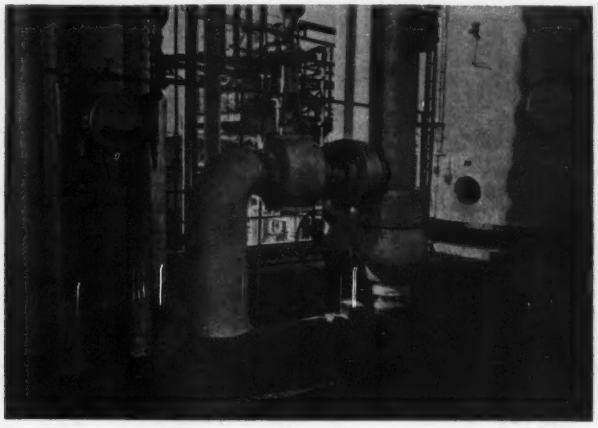




Left, general view of Standard's pressure polymer plant at Richmond where "synthetic" motor fuel is being developed to a high point. Right, this view of the instrument board in control room of treating and rerun plants of Wilshire's Norwalk refinery indicates why the refinery is one of the industy's show places.

Left, a view of a part of the pump area and tower section of vacuum and atmospheric towers at the Oleum refinery of Union Oil Co. Right, some of the control equipment at the Union refinery. All of the Union Oil Co. refinery photographs on these pages were provided through courtesy of J. V. Welsh.





struction projects we find the following: General Petroleum Corp. of California is adding 1400 bbls. daily cracked gasoline production facilities at the Torrance refinery; Shell Oil Co. is adding 2000 bbls. daily straightrun facilities at the Torrance refinery; Shell Oil Co. is adding 2000 bbls. daily straightrun capacity at the Martinez plant; Gilmore is increasing its straightrun gasoline capacity by 1500 bbls. daily at Santa Maria, and Associated Division of Tide Water Associated Oil Co. is adding 1750 bbls. daily to its cracked gasoline production facilities at Avon, and 365 bbls. daily cracked gasoline production equipment at Watson.

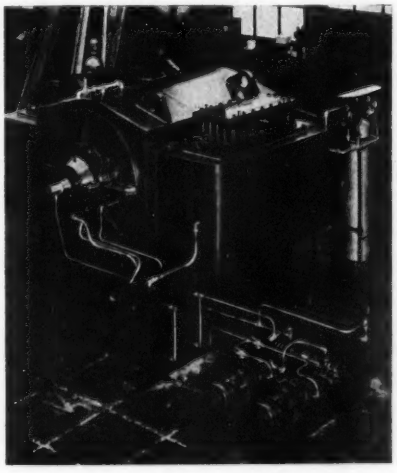
El Tejon Oil & Refining Co. is adding 130 bbls. daily to cracked production at Bakersfield; Hancock Oil Co. is expanding these facilities by 200 bbls. at Long Beach, and Krieger Oil Co. is adding 500 bbls. daily to its straightrun gasoline capacity at Clearwater. Terminals Co. is adding 420 bbls. daily to straightrun capacity, and 420 bbls. daily to cracked gasoline production at Wilmington.

El Centro Refining Co. has just completed the installation of a kerosene treating plant at its Los Angeles refinery. The company also installed a new fractionating tower, larger pumps, additional condensers, etc. to double the refinery throughput. The Norwalk Co. is adding 2000 bbls. daily to its straightrun gasoline capacity at Maricopa. New construction expenditures for O. C. Field Gasoline Corp. total $25,000. The Stockton Oil Co. plans to install cracking facilities at the San Francisco refinery at a cost of $100,000.

While many refiners have found it necessary to increase the throughput of their plants, most of the operators have restricted their building program to rehabilitation and general improvements. Typical of the majority is the Envoy Petroleum Co., which added considerably to its crude oil storage facilities, and whose president, A. M. Lockhart, expresses the smaller operators' view thus: "We believe in keeping pace with progress, more efficiency of operation through better equipment, safety, a clean plant and premises, satisfied personnel through fair treatment, and no further increases in plant capacities."

Unique Motor by General Electric

The first two motors of their type and construction, involving one of the most unusual induction motor designs ever built, have been constructed by General Electric for oil refinery service. These are two-pole, 50-cycle induction motors, rated 1000 hp. at 3000 rpm., and are being installed by C. F. Braun and Co. for Richfield Oil Corp. refinery at Watson, Calif. Inasmuch as such size of motor is beyond the range of labelled explosion-proof Class I Group D design, these motors are provided with a closed-circuit system of ventilation incorporating surface air coolers for removing heat, as well as a valve arrangement for continuously injecting a small amount of inert gas. These features, together with tight enclosures and special seals, provide the operator with a complete arrangement for maintaining a non-inflammable atmosphere, slightly above atmospheric pressure, within the motor.



The closed-circuit cooling system, which is unusual for high-speed induction motors, involves direction ventilation: highly efficient propeller-type fans designed in the General Electric Research Laboratory force the inert mixture over the motor windings through duct, and thence through surface coolers which extract the heat before the mixture is again circulated.

A forced-feed lubricating system furnishes oil to the bearings under pressure by means of two pumps. These pumps operate continuously to maintain a liquid seal at the bearings at all times.

Oil Industry Taxes 12% of National Total

The petroleum industry and-its customers pay approximately 12% of all taxes received by the Federal Government and over 182,000 state and local taxing authorities, according to the annual report of the Shell Union Oil Corp. which has just been forwarded to stockholders.

"The enormous burden of taxation borne by the industry and its customers," said S. Belither, president of Shell Oil Co., yesterday, "is reflected in the total of $78,-333,923 collected through and paid by the Shell Union Group companies in 1937. The upward trend of taxes is clearly shown by an increase of approximately $10,000,000 in 1937 over the preceding year.

"The petroleum industry can point with justifiable pride to its record of steady employment with high wages.

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GULF COAST

HOUSTON, TEXAS; NORCO, LA.

MID-CONTINENT

EAST CHICAGO, IND.; WOOD RIVER, ILL.; ARKANSAS CITY, KANSAS

Field Development

San Joaquin Valley

Deeper Horizon Discoveries In Two San Joaquin Districts

The amazing frequency with which oil bearing sands are being discovered in the San Joaquin valley reached a climax during the past three weeks when the presence of deeper horizons was proved in two fields and two wildcat wells encountered possibly productive sands. Prospecting for oil in the proven Buena Vista gas field, Ohio Oil Co. KCL A-8, sec. 32, 31-26, cored the equivalent of the Stevens sand from 10,022 to 10,140 ft. and found the zone well saturated with oil. Satisfied that the interval is capable of good production, the company is carrying the well deeper, the bottom now being below 10,400 ft.

The Standard Oil Co., after meeting with only mediocre success in developing the upper or "Greeley" sand in the Greeley field, deepened KCL 11-2, located in the northwest corner of sec. 20, 29-26, to 11,520 ft. and has set casing over the top of the Rio Bravo sand which was found at 11,419 ft. Although, as in the case of the Ohio discovery, no formation test was made, both cores and electrical log indicate that excellent production may be expected from the zone.

Apparently having an excellent chance of becoming numbered among the new deep discoveries, Texas Co. Pioneer Unit Plan No. 1, located in sec 33,11-23, six miles southeast of Maricopa, at 8388 ft. cored into a hard sand formation giving acetone cuts and smelling strongly of gas. Now bottomed at 8461 ft., preparations are being made to test the formation.

Those interested with the Texas Co. under the unit plan are General Petroleum Corp., Tide Water Associated Oil Co., Howard H. Bell, L. W. Hood, Blythe & Weatherwax and Gulf & Pacific Oil Co.

Most recent of the new strikes is that of Continental Oil Co. KCL E-1 in sec. 17,30-26, a mile and a half north of Ten Section and two miles east of Canal. At 8172 ft. the drill entered oil sand correlative with that found in the nearby fields, and still in the zone, stopped at 8252 ft. A formation test of the interval recovered salt water, but it is thought the packer failed to hold and it is probable further tests will be made.

The relation of this well and Standard Oil Co. KCL 15-1, lately completed in sec. 27, 30-26, to the Canal and Ten Section fields strongly suggests the presence of another paralleling series of structures, trending northwesterly, and eventually connecting with the Semitropic gas field. Although many wells have been drilled on the now known structural trends, very few attained depths great enough to be considered adequate tests and doubtless an exploratory campaign will now be waged the like of which has not been seen. Discovery of Temblor oil sands in Standard Oil Co. KCL 11-2 in the Greeley field bears out the theory that the middle Miocene will be productive in all the recently discovered valley floor fields. It is difficult to conceive of a situation wherein a structure should contain commercial oil at relatively shallow depths and not yield from lower levels when both source rocks and reservoir sands exist. Normally, the folding forming the great valley fields should extend to sufficient depth to form adequate closures almost to the basement rocks. Undoubtedly the Temblor horizon, in which is found the Rio Bravo or Vedder sand, extends throughout the major portion of the San Joaquin valley, underlying Ten Section, Canal and Canfield Ranch as well as Rio Bravo and Wasco, where it is now productive, and Greeley where it has been cored but not yet tested. In the section below the Miocene cored by Continental's super deep well, oil showings were noted in the Oligocene, the Tumey Shale of the Kreyenhagen, and the Avenal of the Eocene; the latter being the only sandy formation below the Miocene. Though permeability and porosity of the Domengine-Avenal sands were low, there was some evidence to believe that production might have been obtained from the 15,004 ft. level

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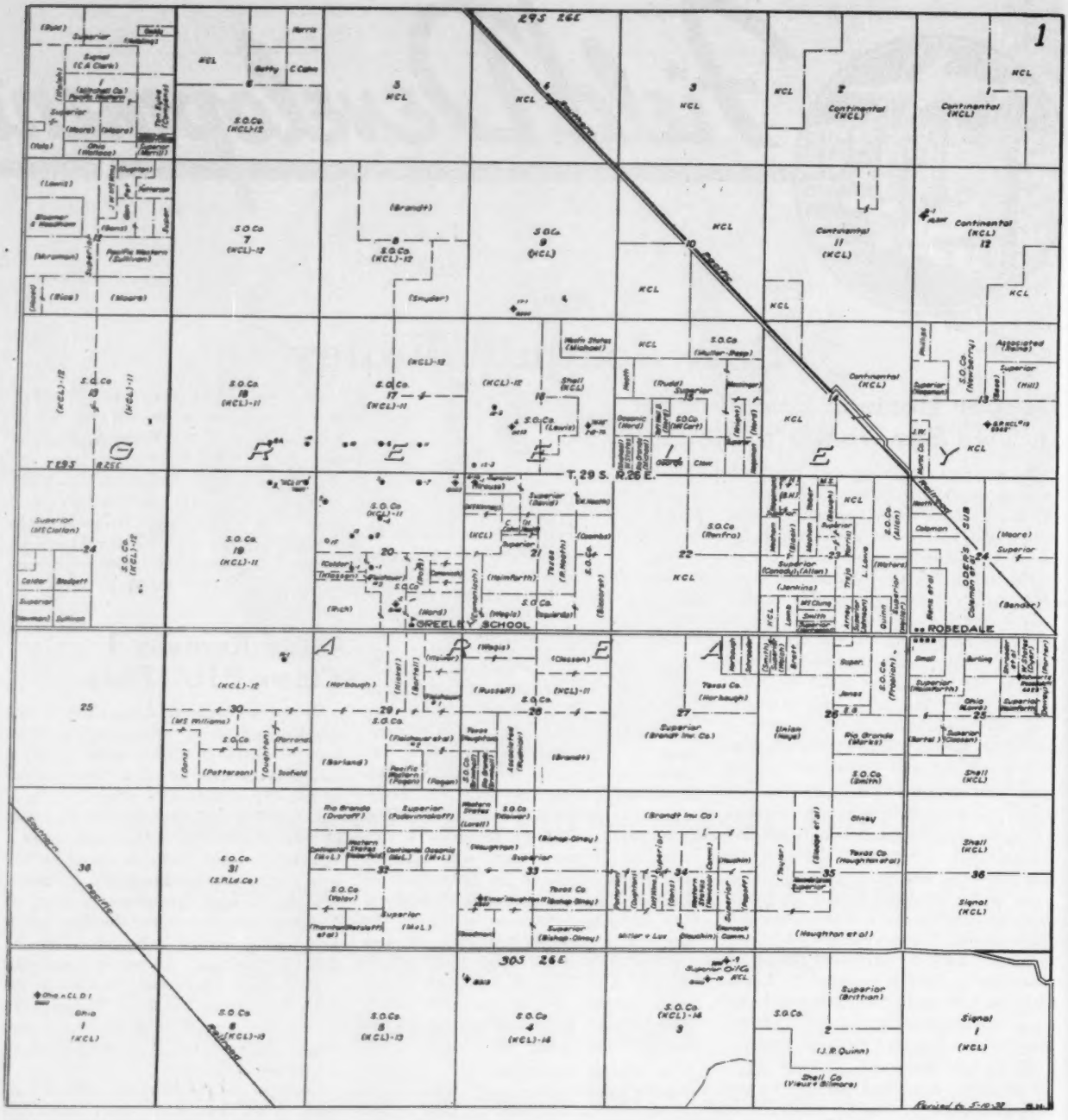
Getty Ramsey 1 Flows 6150 Bbls.

By far the largest completion in the Rio Bravo field was recently obtained by Geo. F. Getty, Inc. when Ramsey No. 1 was finished with an initial flow gauged at the rate of 6150 bbls. a day.

Located near the south quarter corner of sec. 35, 28-25 and somewhat lower structurally than wells in the discovery area, casing was set at 11,370 ft. and a perforated liner landed on bottom at 11,509 ft. Accompanying the flow which was through a one inch orifice, was 6,000,000 ft. of gas. Complying with the "Gentleman's Agreement" in force in the field, production has been beaned back to 500 bbls., the oil being 38 gravity and clean. Ramsey No. 2 is being spudded on the same lease.

Superior Oil Co., with five strings running, is still the field's most active operator. Wagner No. 3 set 7⅝-in. casing at 11,245 ft. and is preparing to core into the oil sand. Wagner No. 4 is below 9100 ft., Anderson No. 1 has passed 10,000 ft., Geisinger No. 2 is at 7530 ft. and Helbling No. 1 is preparing to set surface casing.

Having lost the first hole at 10,100 ft., General Petroleum Corp. is redrilling Wagner No. 1 below 7900 ft. while Wagner No. 2 is drilling at 10,500 ft. Union Oil Co. has temporarily given up attempts to salvage the 11,200 ft. Kernco 34-2 hole and is drilling No. 2 below 5500ft. and is preparing to drill No. 4.



Standard Oil Co. KCL 11-2, which recently discovered the Rio Bravo sand at 11,419 ft. is located near the northwest corner of Section 20.

Map of

GREELEY AREA

Kern County

Supplement to May 14, 1938 issue **California Oil World News Service**

Greeley Activity Hits New Peak

Important has been the last fortnight in the history of the Greeley field. Of major importance to the industry as a whole is the discovery of the Rio Bravo or Vedder horizon in the deep test well, KCL 11-2, located in the northwest corner of sec. 20,29-26. Only slightly deeper than in the Rio Bravo field, four miles northweset, the top of the Temblor oil sand was encountered at 11,419 ft. With bottom now at 11,520 ft., casing has been set over the zone preparatory to making a production test. Two completions were recorded by Standard Oil in the Greeley sand. KCL No. 11-13, located near the west quarter corner of sec. 20, was brought in from the plugged depth of 7755 ft. flowing at the rate of 800 bbls. a day through a one inch bean, the oil testing 37 gravity. No. 11-14 in the southeast corner of sec. 18, was plugged to 7800 ft. and completed for the comparatively small flow of 250 bbls. a day.

Standard's Ross No. 1, southeast edge well in sec. 20, found the Greeley zone barren at 7900 ft. and is now being abandoned at 8110 ft.

Shell Canal A-81 Producing 1875 Bbls.

Another good well was obtained by Shell Oil Co. in the Canal field when KCL A-81, sec. 14,30-25, was bottomed at 8350 ft. and swabbed in initialling 1875 bbls. a day of 36.5 gravity clean oil together with 1,770,000 cu. ft. of gas. A 9⅝-in. water string was set at 8200 ft. and the open hole cased with 165 ft. of securaloy perforated liner. Equipment has been removed to No. A-32, sec. 13, where drilling is progressing below 1500 ft.

Ohio Oil Co.'s only active well, KCL E-6, is now coring for a setting point below 8000 ft.

Western Gulf Hits In North Fruitvale

Western Gulf Oil Co. added another good producer, KCL B-35, to its list in the new northern extension area of Fruitvale in section 14,29-27. With 40 ft. of the Fairhaven sand open to bottom at 3015 ft., the well was completed with an initial flow of over 400 bbls. of 24 gravity oil.

California Western Oil Co.'s northerly outpost, KCL No. 1, is being tested in higher zones after all efforts to complete the well from 3500 ft. ended in failure.

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
Coalinga	Conlon, J. M.	1	25, 19-14	100	Idle
	Magnet Oil Co., Fearon	1	18, 20-15		Rigging up
	Petroleum Sec., Gatchell	2	18, 20-16	6860	Standing cmtd
	Shell Oil Co.	36-1	36, 19-14		Rig
	Diamond	1	35, 20-14	603	Abandoned
	Sec. One	1	35, 20-14	1365	Abandoned
	Wilcox, J. F.	6	11, 20-14	431	Drilling
E. Coalinga	Pure Oil Co., SPL	1	31, 18-17	10861	Fishing
Clovis	Central Valley Oil Co.	1	1, 12-20	588	Idle
Jacalitos Hills	Jacalitos Pet. Co.	1	14, 21-15	5745	Idle
	Dauphin Dev., Boone	1	30, 21-14	3780	Fishing
		2	30, 21-14		Grade
Panoche Hills	Panoche Hills Oil Co.	1	12, 14-11	635	Abandoned
		3	12, 14-11	300	Idle
	Kern County				
Arvin	General Pet. Co., Pauley	1	22, 31-29	500	Idle
	Petrex, Inc.	1	32, 31-30	3635	Cleaning out
	Union Oil Co., Berry	1	15, 31-29	6812	Testing
Belridge	General Pet., St. Helens	1	12, 28-20	7810	Testing
	Ohio Oil Co., Ford	1	6, 29-22	7275	Abandoned
Buena Vista	Ohio Oil Co., KCL	A-8	32, 31-26	10300	Drilling
Comanche Point	Hall-Baker Co.	1	35, 32-29	3257	Abandoned
Devils Den	Amerada Pet. Co., Beer	5	22, 26-19	8295	Drilling
	Gibson Oil Co., Alferitz	3	14, 25-18	410	Drilling
	Little Major Oil Co.	1	36, 25-18	250	Idle
Dominion	Dean, Geo. W.	1	26, 26-28		Rig
Edison	British Cons. Oil Co.	1	11, 30-30	100	Idle
	Johnson, G.W. Brown-Paulette	1	33, 29-30	1027	Idle
	Stevens, Ray	1	22, 30-30		Rigging up
Fruitvale	Texas Co., C.W.L.	1	7, 29-27		Foundation
Grapevine	Ohio Oil Co., Tejon	D-3	28, 11-18	210	Drilling
	Petrol Corp., Reserve	5	32, 11-19		Location
	Richfield Oil Corp.	KCL-1	28, 11-20	1583	Redrilling
Lerdo	Standard Oil Co.	CKL 18-1	29, 28-26	7763	Drilling
McFarland	Tidewater Assoc. O. Co., Pond	1	17, 26-25		Rig
	Shell Oil Co., KCL	83-35	35, 26-25	2550	Drilling
Mt. Poso	Shell Oil Co., Durnal	1	24, 27-28	749	Drilling
	W. P. W. Pet. Co.	3	14, 27-28	153	Drilling
Poso Creek	Reynolds Oil Co.	1	30, 27-27	2855	Cleaning out
	Harkness & Laws, Hunt	1	28, 27-27		Foundation
Richgrove	Dilamar Oil Corp., Quinn	1	15, 25-27	2956	Cleaning out
		3	15, 25-27		Foundation
San Emigdio	Shell Oil Co.	KCL 4-26	26, 11-22	9315	Standing cmtd
Strand	Continental Oil Co.	E-1	17, 30-26	8252	Testing
Temblor Hills	Chico Martinez-Exeter Holly	1	1, 29-20	850	Drilling
	Par-Mer Oil Co., Kendon	1	36, 29-20	700	Idle
	Kings County				
Pyramid Hills	Pyramid Prod. Co., Retherford	1	27, 24-18	3090	Idle
Kettleman	Temblor Oil Co., Bunting	1	25, 23-18	9138	Plug 7815—Idle
	Tulare County				
	Baringer, Corbridge & Gound	2	29, 24-28	820	Drilling
Ducor	Nelson & Davison	1	1, 24-27	157	Drilling
Tipton	Magnet Oil Co., Glaze	1	15, 22-26	3282	Cleaning out

Belridge Test Dropped by Ohio

Although major discoveries feature current news the odds remain very much against the wildcatter. Among Kern county test wells recently given up are: Ford No. 1 of the Ohio Oil Co., drilled to 7275 ft. in sec. 6,29-22 near Belridge, and Hampshire No. 1 of John W. Austin which was abandoned when the base of the Etchegoin, cored at 2960 ft. proved unproductive. On the east side of the valley, Shell Oil Co. cored through barren Vedder and Walker sands to the top of the granite at 1605 ft. before abandoning Johnson No. 1 in sec. 30,27-28. Seeking an extension of north Mount Poso production, Coronado Oil Co. found only gray sand in the Vedder zone topped at 1615 ft. in sec. 28,26-28 and Coast Exploration Co. was forced to abandon Coast No. 1, a Round Mountain extension well in sec. 6,28-28, when no commercial oil was found to 2033 ft.

Standard to Drill For Wasco Pay Sand

That the Wasco field is not to be a one well oil field is seen in the recent announcement of Standard Oil Co. to drill two wells to the 13,100 ft. sand productive in Continental Oil Co.'s discovery, KCL No. A-2. At the same time, the latter company staked a location for a third well one location north of A-2. Standard's Mushrush No. 1 will offset Continental to the west in sec. 7, 27-24, but KCL is located in the north quarter of sec. 17, nearly 2000 ft. south of the property line.

These wells are the first ever started with the deliberate intention of drilling over 13,000 ft.

Indicating that the world's deepest well is a commercial producer in every sense of the word, Continental Oil Co. opened the flow bean on KCL A-2, sec. 8, 27-24, to one inch on a two day test, increasing production to over 3600 bbls. a day with a flow pressure of 375 lbs. Gas production climbed to 1,700,000 cu. ft. Since completion a month ago, gravity of the oil has dropped from 40 to 35 degrees. Again beaned back to 8/64 in., production averages 400 bbls. daily.

Caminol Acquires Magnet Trico Test

The first independent company to enter the valley floor deep drilling campaign since the recent important discoveries by major companies is The Caminol Co., Ltd. of Los Angeles. Having acquired the old Magnet Oil Co., A. G. G. No. 3 well in sec. 29 -4-24, Caminol will re-enter the 7555 ft. hole and deepen in search of production in the local equivalent of the Stevens, Rio Bravo, and Avenal sands.

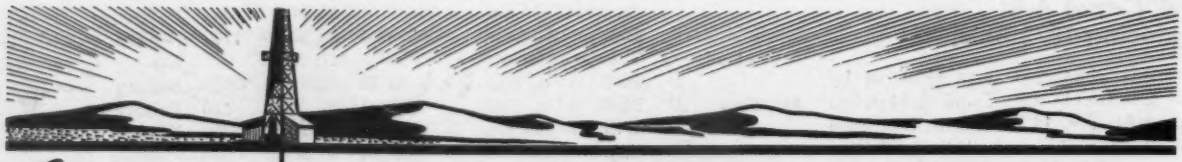
Paleontology of the cores places the top of the McLure shale at 6800 ft., leading the company to believe that the Stevens-Greeley zone, if present, will be encountered above 8000 ft. Should the horizon be too silty to form an adequate reservoir, as is the case at Wasco, the test will be carried down to the Olcese, Jewett sands of the Temblor. Unverified reports place the well several hundred feet higher structurally than Morris No. 1, sec. 36, 24-23, abandoned by Standard Oil Co. in January of this year at 11,468 ft. in what is thought to be Eocene. If these assumptions are correct, a test of the complete geologic section of the valley can be made by the new operator at a very reasonable cost.

Caminol's holdings total 1600 acres in the vicinity of the well, while other companies, including Standard, Superior, Magnet, Ohio, Barnsdall, Continental, Amalgamated Oil & Gas, and Formax are also interested in the area.

Say Gatchell No. 1 May Be in Avenal

Reports emanating from Fresno, scene of the partition suit involving Petroleum Securities Co., Gatchell No. 1 located in sec. 18, 20-16, indicate the bottom of the hole to be 6849 ft. and the casing to be set at 6690 ft. Oil sands are said to have been cored between 6711 and 6724 ft., and between 6814 ft. and bottom. In view of the present tendency to rely on seismograph results, it is interesting to note that this well was located solely on the basis of geologic field work.

The well is yet standing cemented, no test being contemplated until the legal difficulties are completely settled. Although no information has been released by the company, the sands are believed to be the Avenal horizon which is productive below 10,000 ft. in Kettleman Hills and outcrops north of Coalinga.



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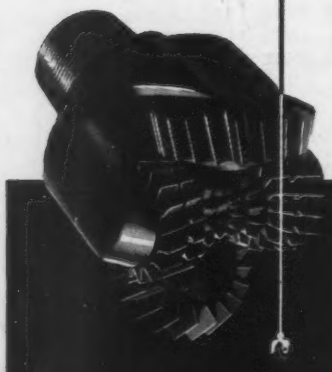

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Magnet in Coalinga Testing Sec. 18, 20-15

Entering the Coalinga area, Magnet Oil Co. is rigging up to drill a deep test well in sec. 18,20-15, six miles due west of Petroleum Securities Co.'s mystery well, Gatchell No. 1, which is still standing idle.

J. F. Wilcox, veteran Coalinga operator, is drilling his No. 6 well in sec. 11, 20-14.

Shell Freeman 19 Extends R. Mountain

Extending the proven area of the older portion of the Round Mountain field to the east, Shell Oil Co. completed Freeman No. 19 with a potential of 786 bbls. of 16.5 gravity clean oil. With only 15 ft. of the prolific Vedder sand open to bottom at 1830 ft. the well was brought in on the pump. Located near the east quarter corner of the southwest quarter of sec. 20, 28-29, Honolulu Oil Co. will probably be forced to drill an easterly offset.

Crestmont Oil Co., Staley No. 3, recently completed in sec. 8, 28-29 as a small producer, is being deepened in an attempt to improve the yield.

Hopper Canyon Test In Doubtful Column

Status of Continental Oil Co.'s intended deep test in Hopper Canyon is now somewhat doubtful. The well, known as Elkins No. 1 and located in sec. 23, 4-19, passed through either a fault or an overturned fold and re-entered Pliocene formations at 4100 ft. Although still drilling below 4140 ft., the well may be soon in the abandoned list. Formation tests between 3150 and 3400 ft. indicated small production might be obtained at that interval.

General Plugs Back Its Belridge Wildcat

After a stubborn fish in the hole all but precluded further deepening, General Petroleum Corp. plugged its Belridge wildcat, St. Helens No. 1 to 1400 ft. and is making a test of the shallow zone which appeared to have a "kick" when first cored. The 16-in. surface pipe has been perforated between 1200 and 1400 ft. and bailing to date has revealed possibilities of obtaining small production. Located a mile south of North Belridge in sec. 12, 28-20, the drill pipe fish was lost on bottom at 8685 ft.

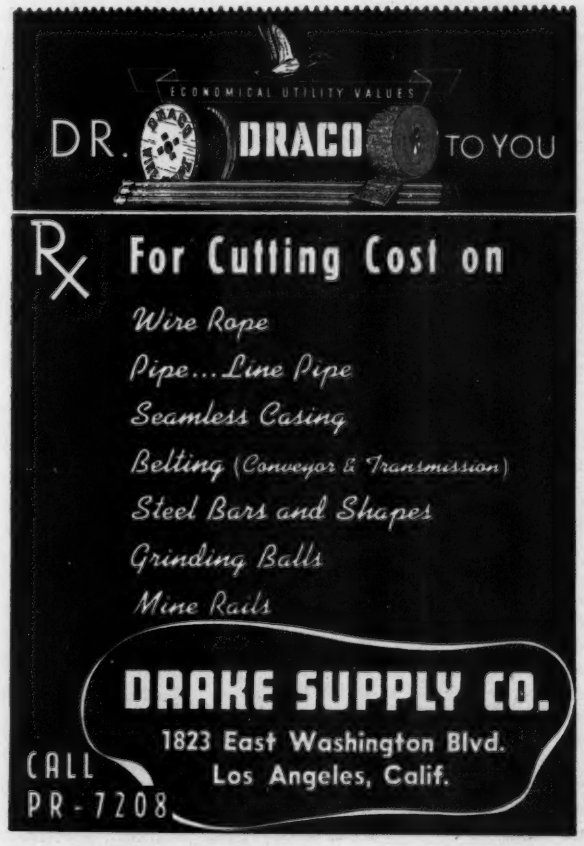
Gravel Packing Aids In Section 33, 11-19

Recompletion of Universal Consolidated Oil Co. No. 1, sec. 33, 11-19, after gravel packing, resulted in a slight increase in production. Pumping from the same interval, 4435 to 4553 ft., the net recovery is now 110 bbls. of 22 gravity oil. Water cut remains at 30%.

Ohio Oil Co. has spudded its Tejon No. D-3 in sec. 28, 11-18 and The Petrol Corp. has made a location for Reserve No. 32-5 in sec. 32, 11-19.

Union Berry 1 Arvin Producing Water Only

Falling far short of fulfilling the high expectations held for the well, Union Oil Co., Berry No. 1, located two miles northwest of Arvin in sec. 15, 31-29, would not respond to swabbing and placed on the pump, produced only 50 bbls. a day, all water. Carried originally to 6812 ft., the hole was plugged and redrilled to 6135 ft. at which point the test was made. A string of 5⅛-in. casing was set at 5908 ft. and a liner including 215 ft. perforated was landed on bottom.



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Los Angeles Basin

Wilmington Operators Holding Down Output

Maintaining the total field production at Wilmington at the 100,000 bbl. mark in the face of seventeen new completions in the past two weeks is looked upon as something of a cooperative triumph for the operators. Good as is record of voluntary curtailment, it is still obvious that production exceeds consumption by a margin about equalling the daily output of this field and that unless producing companies throughout the state and Wilmington in particular voluntarily shut in further, an early market break is inevitable.

Of the new producers, nine were completed in the Terminal zones, capable of large production, but were held to relatively low initials in accordance with the conservation agreement. Seven wells were brought in from the Ranger zone with yields varying between 200 and 500 bbls. In the Wilmington central townlot area, Pacific Western Oil Co. perforated casing in Ronan Community No. 1, a Ford zone well, from 5185 to 5300 ft. obtaining a 450-bbl. flow of 29 gravity oil.

On the Baxter property, Hollywood Oil Co. is completing its first well after plugging off the barren lower Terminal zones. In the Ranger and upper Terminal production is expected to run well over the average of wells producing from the upper horizon alone.

Richfield Oil Corp. finished Pacific Dock No. 26 at 3216 ft. with a settled yield of 535 bbls. through a 24/64-in. bean and No. 19 from 3140 flowing 500 bbls. Proctor & Gamble No. 1, a Terminal well, came in at the rate of 1800 bbls.

Graham No. 2 was brought in by Hogan Petroleum Co. flowing 200 bbls. from the Ranger zone and equipment has been moved to No. 3 which is now drilling below 2450 ft. Hancock Oil Co.'s first upper zone well, No. C-17, was completed with a gravel packed liner, the flow estimated at 300 bbls. a day.

General Petroleum Corp., with two Ranger and two Terminal wells, led in number of completions, while Union Pacific Railroad was next with three, all in the lower zones. Superior Oil Co. and A. T. Jergins on the Backbay lease obtained typically large production from the lower zones in well No. 8, their second Terminal completion in the field.

The eighth and last active well on city owned land was completed by the Termo Co. Located near the Edison plant, the well was bottomed at 3900 ft.

Success of recent reperforating jobs in the Ford zone in the Wilmington area has led to deepening activity on the part of several operators which may culminate in a mild boom, as the production obtained, though small, is of good quality and readily marketable.

Hancock Day No. 1 Yorba Linda Failure

Many failures and semi-failures of late have dampened the enthusiasm of Yorba Lindo operators. Most serious recent blow was Hancock Oil Co.'s Day No. 1, which was carried to 3568 ft. in search of a deeper sand but on finding nothing commercial, was plugged back to the 2300 ft. zone. Formation tests at this point indicated only possibilities of small production and the well was turned to Geo. C. Creager for further tests.

Hilldon's Pool 2 Pumping 300 Bbls.

Latest completion in the Long Beach northwest extension area is Hilldon Oil Co.'s Pool No. 2, pumped in from 4167 ft. with an initial gauge of 300 bbls. per day. Equipment was removed to Amebco No. 4, which is being rigged up as an offset. Pool No. 3 is drilling below 2980 ft. and will be the company's next producer.

The joint project of A. A. MacDonald and Signal Oil & Gas Co., Pacific Electric No. 1, has cemented casing at 3858 ft. and is "drilling in" to complete. A. S. Johnston Drilling Co., well No. 33 and Richfield Oil Corp., Bixby No. 5 have water strings standing cemented preparatory to putting in production.

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
Los Angeles County					
Bellflower	Clayton, Geo. L. Scott	1	32, 3-12	6820	Idle
Brea	Pressel, Perry, Tull	1	30, 2-9	4560	Idle
Castaic	Royal Land Corp.	1	8, 4-17	555	Drilling
La Mirada	Carmenita Oil Co., Ravera	1	21, 3-11	50	Idle
Lomita	D & B Oil Co.	1	25, 4-14	5050	Drilling
Monterey Park	Monte Cristo, Garvey	1	27, 1-2	5425	Drilling
Mint Cnayon	Christien, J. P.	1	7, 4-14		Rig
	Mint Canyon Oil Co.	1	33, 5-14	1860	Idle
Newhall	Barnsdall Oil Co., R.S.F.	3	36, 4-17	5150	Drilling
	National Pet. Corp.	1	27, 4-16	2435	Idle
	Palmluck Oil Co.	1	23, 3-16		Rigging up
Palmdale	Antelope Valley Pet.	1	17, 6-12	50	Idle
Palos Verdes	Gene McLaren	1	27, 4-14	3992	Idle
	Rolling Hills Pet.	1	27, 4-14	4220	Idle
Pico	British Am. O. P. Co.	1	12, 2-12	4568	Drilling
	A. S. Johnston, Univ. Cons., Pico	1	5, 2-11	5628	Idle
Pico Canyon	Burt, A. G.	1	36, 4-17	2550	Idle
San Fernando	Tidewater Assoc. Porter	1	27, 3-16		Grading
Towsley Canyon	Towsley Canyon Oil Co.	1	8, 3-16	4100	Pumping
W. Long Beach	Pioneer Petrol Corp.	1	26, 4-13	5147	Abandoned
Whittier	Langstaff, Geo. W. Iliff	1	8, 2-11		Rigging up
	Riverside County				
Murrietta	Fidelity Realty Corp.	1	21, 7-3	32	Drilling
	San Bernardino County				
Chino	Carbon Canyon Oil Co.	1	31, 2-8		Foundation
	So. Counties Pet. & Drlg. Co.	1	26, 2-8		Rig
	Orange County				
Anaheim	Shell Oil Co., Weisel	1	16, 4-10	2100	Drilling
Costa Mesa	A. V. Oil & Gas Co.	1	16, 6-10		Rigging up

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Colusa	Amerada Pet. Corp.	C.L.C. 1	34, 16-1		Grade
Glenn	Ohio Oil Co., Willard	2	18, 20-2	3500	Drilling
Humboldt	The Texas Co., Eureka	2	22, 3-1	7708	Plug 6473-Shut in
Monterey	The Texas Co., Lewis	1	13, 19-5		Grade
San Mateo	Wilshire Oil Co., Cowell	1	20, 6-5	8007	Idle
Solano	Amerada Pet. Co., S.&S.J.	2	18, 14-3	3510	Drilling
	Richfield Oil Co., Potrero	1	10, 4-1	3310	Drilling
	Standard Oil Co., Anderson	1	1, 3-2	4458	Completed—Gas
	Texas Co., Midland Fee	1	4, 3-3		Foundation
Sutter	Buttes Oil Fields, Ltd.	3	2, 15-1	6954	Shut in

Torrance Deep Pay Shows Higher Yield

Completion last month of better than average producers in the Torrance deep zone has led to an appreciable revival of activity in the field. Number of active projects jumped almost over night from twenty to thirty, despite several completions. Although Standard Oil Co. completed Martin No. 1, near Sepulveda west of Pennsylvania, flowing 300 bbls., activity now centers between 229th and 233rd St., with some operators stepping even farther out. Of the several wells now ready for completion, some report very good oil sand and it is not unlikely that the 600 bbl. production record set by MacDonald & Burns, Moore No. 3, will be broken in the near future, especially as development progresses to the south.

Collapsed casing has delayed production tests in three wells and seems to be the most prevalent mechanical difficulty encountered in the field.

Tending to revolutionize future casing programs, Consolidated Oil Co. through its engineer, M. H. Soyster, obtained permission of the Oil & Gas Commissioners to set a single string of pipe over the lower zone at 4914 ft., protecting the the upper sands with the new Lane-Wells multiple stage method of cementing through perforations. The Division of Oil & Gas heretofore has refused requests to follow this procedure as all previous proposals were to cement the upper stage above the main zone, while Mr. Soyster proposed cementing below, at 3845 ft., using enough sacks to seal off the entire thickness of oil sand. Commissioners concurred in the opinion that this program would afford maximum protection to the Main zone at minimum cost to the operator. With excellent prospects of obtaining good production, Consolidated's Torrance No. 1 is now bottomed at 500 ft. and is preparing to test.

Potrero Club Test Indications Favorable

After encountering 60 ft. of apparently productive formations, Basin Oil Co. stopped drilling its Potrero well at 4745 ft. and set casing at 4685 ft. preparatory to making a production test. The well is located on the Potrero Country Club property near the intersection of Prairie and Manchester and is accorded an excellent chance of obtaining commercial production.

Increased railroad freight rates authorized by the Interstate Commerce Commission on March 8 will become effective on March 28, according to an announcement by the Commission.

New Union Oil Rosecrans Well

Completed in the seventh zone, the deep Miocene producing formation in Rosecrans field south of this city, Union Oil Company's Rosecrans No. 19 was swabbed in flowing 1207 bbls. of 32.3 gravity oil through a 48/65-in. bean. Water content was 6%. It was bottomed at 7633 ft., with casing set at 7292 ft. Gas output was estimated at 860,000 cu. ft.

Drilling crews were moved to Rosecrans No. 20 and already have spudded in this well. It is located to the northwest of No. 19, adjacent to the Pacific Electric Railway tracks, between Broadway and Figueroa Sts. and north of Rosecrans Ave.

Barnsdall Oil Co. topped the sand in Trust No. 3 at 7290 ft., and after setting casing, will core ahead to slightly below 7600 ft. before completing.

H. B. Oil Co. and Howard Oil Co. have suspended operations pending the outcome of Superior Oil Co., Maxwell No. 8, which is approaching 7100 ft. in depth. Universal Consolidated Oil Co. has passed the 6000 ft. mark in Trust No. 3.

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As a class, oil men are a pretty husky lot of individuals, and it takes something pretty substantial to knock them out of commission. Just a few days ago a rig builder dropped a hammer from the top of the derrick, and it bounced off the head of the construction foreman who stood on the floor below. Looking aloft he remarked, with infinite scorn in his voice, "A little more careful there, Buddy. You nearly made me bite my tongue."

And **George Dudeney** points out, much to our surprise, that the English word "petrol," and the American word "gasoline" are both synonymous, although he frankly admits that gasoline is much the more synonymous of the two.

Also, according to **Frank Lamb,** the greatest contribution ever made to the cause of safety in the oil industry was the issuance of a mandate against the use of worn and defective tools. Frank says the worst accident he ever saw occurred when an old monkey wrench went off its nut.

George Arnold now sends in an editorial culled from an oil town daily expressing the pride of California in its "movie actors and other citrus fruits."

While **Dub Russell** interrupts to remark that lots of first hand information has been acquired from second hand cars.

And, on the same topic, **George Thompson** says it is nothing but foolishness to act like a wild animal when you find yourself in a trap.

At this juncture the old maestro, **Dave Kilgour,** voices the opinion that the sincere desire of every oil man is to have a nice home and a good auto to get away from it.

Next we have **Roy Fry** asking if the creak of the walking beam is what they call swing music.

On this same subject, we ran into **Clarence Froome** over at the Drunkard a short time ago, and in a post mortem discussion he opined (Clarence is one of the best opiners in California) that the show was one of the most moving histrionic exhibits in the City. "Why!" he concluded, "There wasn't a dry throat in the house."

Earl Stillwell had an applicant for work last week, who was formerly employed as a worm hole borer in an antique furniture factory.

Which recalls **Wynn Lynch's** old story about the lad who was a spotter in a domino factory and was laid off every time they made the double blanks.

And, if you'll pardon us dragging in the family again, we ourself once had an uncle who was a steeplejack. He rose to great heights in his chosen profession.

But he came down by the direct route one day from an unusually high steeple, and aunty married an oil man with a small interest in a community lease and a big interest in the blond waitress at the oil field cafe.

Oh, well, as **Doc Hudson** used to say, "When business is bad, don't get excited, just go hunting—new business."

"Wick" Wickersham, on the other hand, tells about a Brea lad who was absent from church so long that when he went last Sunday he had to take his buddy along to identify him.

And when you see an oil man down town with his coat collar up, don't assume that it is cold. He is probably wearing the new tie his wife bought him.

All of which brings us to the end of another productive session. Remember that oil workers may come and oil workers may go, but mostly the latter.

Above all, bear in mind that you can't invest too much in the bonds of friendship.

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DRILLABILITY

ONLY COMPLETELY DRILLABLE MATERIALS ARE USED IN THE INTERNAL CONSTRUCTION OF BAKER FLOATING UNITS.

St. Helens Monterey 25 Solves Water Problem

Believing the answer to water difficulties in the west Montebello Fifth zone is to be found in more carefully choosing the sands to be produced, St. Helens Pet. Co. bottomed Monterey No. 25 at 5790 ft. and cemented the liner through perforations at 5710 ft. That the theory was correct is borne out in the final completion of the well at the rate of 1500 bbls. a day of 37.8 gravity oil cutting only 0.5%.

Not so fortunate in excluding formation water was McVicar & Rood, Manz No. 1, which was finished at 5785 ft. with perforations open from 5415 to 5575 ft. and from 5720 ft. to bottom, the blank interval being cemented. On completing, the 2500 bbl. production showed a water cut of 7.5%.

Union Oil Co., adopting the same procedure as St. Helens, bottomed Paul Howard No. 1 in the Sixth zone at 6245 ft. and plugged 5715 ft. where a liner was landed and cemented through perforations 74 ft. above the shoe. Production test showed the cement job to be a failure, however, as the 1800 bbl. flow cut 61% salt water.

On first water shut off test, St. Helens, Monterey No. 26, with the hole open from the casing shoe at 5445 ft. to bottom at 5452 ft., flowed at the gross rate of 50 bbls. per hour, the cut increasing from 17% to 80% at the conclusion of the test. The well is now standing recemented. Union Oil Co. is preparing to test casing set in Wilcox No. 1 at 6137 ft. after a clean oil flow was obtained on formation test from that point to bottom at 6248 ft. This will be a Sixth zone completion.

Plan New Test At Costa Mesa

One of the most drilled unproven areas in California is to have a new test with the starting of work at Costa Mesa, Orange county, by the A. V. Oil & Gas Co. Located at the intersection of Hamilton and Placentia Sts., the well is expected to prove once and for all the potentialities of the bluffs overlooking Newport Harbor. The A. V. Oil & Gas Co. is a subsidiary of the identically named concern having headquarters in Dundee, Michigan. Beside the Costa Mesa leases, the company holds a large block of acreage in Madera county.

Modifications in the recently adopted restrictions on the cutting of Los Angeles street curbs for driveways have been proposed by the California Oil and Gas Association in a report submitted to the Los Angeles Board of Public Works.

California Crude Oil Production

For Two Weeks Ending May 7, 1938

Field	May Daily Quota	Average Daily Production	Excess
San Joaquin Valley			
Belridge—North	15,600	12,661	*2,939
Belridge—South	1,850	1,095	*755
Buena Vista	17,745	18,212	467
Canal	1,720	1,939	219
Coalinga—East-West	16,240	11,587	*4,653
Coffee Canyon	3,445	4,129	684
Edison	2,880	3,483	603
Elk Hills	8,305	10,926	2,621
Fruitvale	7,230	9,290	2,060
Greeley	3,630	3,102	*528
Kern Front	9,293	9,241	*52
Kern River	5,320	27,862	*2,534
Kettleman No. Dome	67,535	78,502	10,967
Lost Hills	4,535	3,856	*679
McKittrick	3,505	3,837	332
Midway	46,220	41,115	*5,105
Mount Poso	16,121	18,903	2,782
Mountain View	9,690	12,030	2,340
Rio Bravo	1,730	2,949	1,219
Round Mountain	10,540	11,633	1,093
Ten Section	5,930	5,992	62
Other Fields	2,795	2,992	197
TOTAL	261,859	270,260	8,401
Coastal Counties			
Elwood	5,645	6,431	786
Rincon	2,970	4,395	1,425
Santa Maria	8,400	5,515	*2,885
Santa Maria Valley	17,260	7,304	*9,956
Santa Paula-Newhall	5,165	4,825	*340
Ventura Avenue	33,950	36,560	2,610
Other Fields	5,970	6,390	420
TOTAL	79,360	71,420	*7,940
Los Angeles Basin			
Alamitos-Seal Beach	8,445	8,922	477
Brea-Olinda	8,665	5,534	*3,131
Coyote—East	2,030	3,442	512
Coyote—West	8,605	8,793	188
Domingues	23,265	26,486	3,221
El Segundo	9,030	12,149	3,119
Huntington Beach—New	14,495	19,146	4,651
Huntington Beach—Old	13,950	15,653	1,703
Inglewood	14,830	15,544	714
Long Beach	47,631	58,773	11,142
Montebello-Extension	7,695	8,970	1,275
Playa del Rey	6,240	6,870	630
Richfield	8,425	8,833	408
Rosecrans-Athens	4,210	6,789	2,579
Santa Fe Springs	32,055	37,664	5,609
Torrance	7,860	7,760	*100
Wilmington	62,665	100,435	37,770
Other Fields	2,540	2,593	53
TOTAL	283,536	354,358	70,820
STATE TOTAL	624,755	696,036	71,281

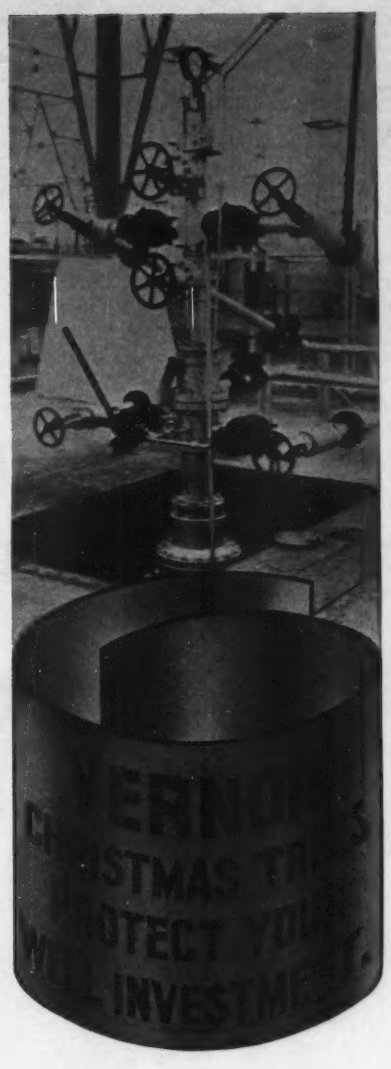
*—Shortage.

D & B Test Indicates Torrance Extension

Indicating a new southeasterly extension of the Torrance field, D & B Oil Co., located at 253rd St. and Vermont Ave., is reported to have encountered nearly 40 ft. of oil sand to 5220 ft. Coring will continue to determine the extent of the sand body before setting casing. The company controls 100 acres in the vicinity, and if a successful completion is obtained in the first well, plans a conservative development program.

East Mount Poso Is Still Prospected

Continuing its East Mt. Poso exploratory pjrogram, Shell Oil Co. moved equipment from Johnson No. 1, abandoned at 1600 ft. in granite, and is drilling Durnal No. 1 below 750 ft. in sec. 24, 27-28.



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Coastal District

Santa Maria Cut May Slow Drilling

Drastically slashing the price of Santa Maria crude to an average of 45 cents a barrel, Union Oil Co. served notice that the much talked of overproduction is more than a mere threat and that producers in the new field must cooperate to confine production within the limits set by consumption. Most observers agree that the new price will not only serve to reduce production but will soon stop all new development as many leases contain clauses suspending drilling obligations when the market price falls below 50 cents. Having the only pipeline outlet, Union has been forced to handle practically all the field's output, a condition expected to be relieved somewhat by independently owned refineries now under construction. Not effective until May 20, the price cut has not yet greatly altered conditions.

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Of the several wells lately completed, the largest was Vicente No. 4 of Geo. F. Getty, Inc. which flowed initially 2800 bbls. of 16.5 gravity clean oil through a one inch bean. The well, located in sec. 27, 10-34, penetrated the Franciscan 10 ft. to 4700 ft. and is producing from 400 ft. of Monterey. Bank of America through its operating subsidiary, California Lands, Inc., completed two wells, the largest being McDonald No. 1 in sec. 28 which gauged nearly 2300 bbls.

The 8⅝-in. casing was set at 4800 ft. and the hole is bottomed five feet in the Franciscan at 5225 ft. The fourth Gallison well was finished at the plugged depth of 5330 ft. flowing 4500 bbls. daily.

The combined operators, Hancock and Bush, who with Union Oil Co. and A. N. Macrate pioneered the field, just put Bradley Lands No. 2 on production with no estimate of the yield available. The Monterey is open 535 ft. to bottom at 5035 ft.

The smallest well yet obtained in sec. 27 is F. E. Jones Wisconsin-Waddell No. 2 which, with 350 ft. of formation open to 4657 ft., pumped only 150 bbls. a day. The casing is being reperforated in an attempt to improve the output.

Finishing Yelkin No. 1 at 4582 ft., Signal Oil & Gas Co. obtained a clean flow of over 1500 bbls. and moved equipment to No. 12 which is now drilling below 3000 ft. Sunshine Oil Co. Wallace No. 4 topped the Monterey at 4000 ft. and is now "drilling in" to complete after setting casing at the contact.

Union Oil Co.'s important west extension well, LeRoy No. 3, is now preparing to complete after reported topping the Chert at 4975 ft. and the Franciscan at 5375 ft. Two other union wells are drilling in the Moneterey, O'Donnell 2-2 and Bradley Lands No. 3, while Stinson No. 1, finished at 5128 ft. in the schist, is on production for 250 bbls.

Beaufoy No. 1 of Wilson Oil Co., whose casing collapsed shortly after completing, is endeavoring to clean out the hole to repair the pipe.

Ohio Oil Co. stopped drilling in its first sec. 27 well, Morrison No. 1, at 5195 ft. and is preparing to complete.

On finding the Monterey barren, Valoco Oil Co. abandoned its test of the Haslam property in sec. 28, 10-33 at 1653 ft.

The mystery of how oil-bearing rock is formed may be answered as the result of an intensive study which will be begun immediately at the University of California's Scripps Institution of Oceanography.

Petrol Gato Ridge 21 Producing 2256 Bbls.

Petrol Corp. completed its first well on the Tognazzini lease at Gato Ridge since its recent resumption of activity in the area. Well No. 21, sec. 9, 8-32, was bottomed at 2612 ft. and with formations open from 1855 to 1900 ft. and from 1922 to 2592 ft. initial production on the pump gauged 2256 bbls. in the first 23 hours. The oil is 14 gravity and entirely free of water. Petrol's lately acquired eastern market for the oil enables the company to operate independently of the pipeline companies.

Standard Below 5225 In Cat Canyon Wildcat

Standard Oil Co.'s test of the Cat Canyon area, Los Flores Land & Oil No. 1, is now redrilling below 5225 ft. Drilled originally to 5529 ft., considerable difficulty was experienced in maintaining a straight hole in the hard shale formation.

Test Below 4310 In Sec. 7, 9-33

Bankline Oil Co., Silva No. 1, important exploratory well in sec. 7, 9-33 near Orcutt, has now attained a depth of 4310 ft. without having encountered productive horizons. Southern California Drilling Co., Houk No. 1 in sec. 9, 9-33, continues to pump water with a small amount of oil from the plugged depth of 3950 ft. No further work has been done on the Garrett property in sec. 12, 9-34 since Warren Deuel erected a derrick several weeks ago.

Lose Formation Tester In Johnson Oxnard Well

Walter G. Rowe, Johnson No. 1, Oxnard test in which several major companies are interested, was deepened to 4480 ft., where a formation tester was lost in the hole. Setting the packer at 4100 ft., a light blow was noted, but on attempting to pull the tester, the drill pipe parted 20 ft. off bottom.

Two Wells Drilling In Ojai District

Two wells are now active in the Ojai district of Ventura county. High Mesa Oil Co., Butcher No. 1 in sec. 16, 4-22 is drilling in Sespe formations below 1535 ft. and St. Louis Oil Co. is preparing to clean out Pirie No. 1 in sec. 18. Bottom has been plugged from 2700 to 1750 ft.

General Pete El Capitan Pumping 140 at 1400 Ft.

After several months of inactivity, General Petroleum Corp. re-entered the El Capitan field and drilled Erburu No. 22 to 1400 ft. where the well was finished with an initial yield of 140 bbls. of clean oil.

J. E. O'Donnell Tests In Lompoc District

J. E. "Jim" O'Donnell, long active in California as an independent operator, has started a new wildcat project in the Lompoc area of Santa Barbara county. Only recently spudded, the well will be carried down into the Miocene in search of the Monterey production found in other coastal fields. The new test is located in sec. 8, 7-33 and is drilling below 1100 ft.

Padre Canyon Location

Chanslor-Canfield Midway Oil Co. is planning an early resumption of operations in Padre Canyon, having staked a location for Oak Grove No. 7 in sec. 23, 3-24.

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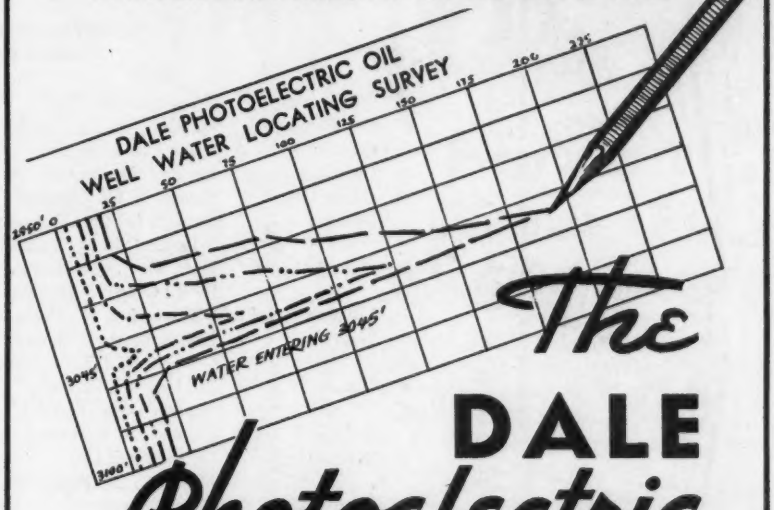

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Continental Testing In Section 24, 8-31

Southeast of Los Alamos, Continental Oil Co. is starting what may be one of the most important coastal district exploratory wells of the year. Located in section 24, 8-31, the well will test a structure long regarded as having excellent prospects of becoming productive and will be watched with interest by the entire oil fraternity.

Merchant Cochrane 8 Below 535, Sec. 1, 4-20

Merchants Pet. Co., Cochrane No. 8, located in sec. 1, 4-20 in the Sespe district of Ventura county, is now drilling with cable tools below 535 ft. Section 20 Oil Co. is cleaning out to resume drilling its No. 1 well, suspended at 1600 ft. last fall. The well is located in sec. 20, 5-19 near Tar Creek.

Hollister Sec. 35, 5-33 In Sespe at 3850 Ft.

Wilshire Oil Co., Hollister No. 1, sec. 35, 5-33, cored 100 ft. of Vaqueros gray sand to the top of the Sespe at 3400 ft. and is drilling ahead in the latter formation at 3850 ft. Remedial work is being done on the adjoining Gaviota Oil Co. well which turned to water after supplying gas to the Wilshire project for several months.

Ventura Ave. Outpost Drilling Below 6600 Ft.

Lloyd Corp. No. 1, important Ventura Avenue outpost well being drilled under contract by Sunset Oil Co., is now in hard shale with streaks of sand below 6600 ft.

In the proven area, Tide Water Associated Oil Co. completed Lloyd No. 68 at 4800 ft. flowing 250 bbls. a day on gas lift.

COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
Santa Barbara County					
Carpinteria	Carpinteria Oil Co.	1	32, 4-5	2340	Drilling
Cat Canyon	Standard Oil Co., Los Flores	1	27, 9-33	5530	Redrilling
Coal Oil Pt.	South Crude Oil Co.	191–1	24, 4-29	5510	Redrilling
Carreaga	Douglas-Stratton Oil Co.	1	8, 8-33	2105	Drilling
Garey	Valoco Oil Co., Haslam	1	28, 10-33	1655	Abandoned
Gaviota	Gaviota Oil Co., Hollister	1	35, 5-33	3205	Recemented
	Wilshire Oil Co., Hollister	1	35, 5-33	3843	Drilling
Gato Ridge	Field, O. C., Continental	3	9, 8-32		Rig
	Petrol Corp., Tognazzini	1	9, 8-32	2612	Completed
Lompoc	O'Donnell, J. E., Helen	1	8, 7-33	1431	Drilling
Los Olivos	United Western, Bradley	1	15, 7-30	3140	Drilling
	Continental Oil Co., Laguna	1	24, 8-31		Location
Orcutt	Bankline Oil Co., Silva	1	7, 9-33	4385	Drilling
	Warren Deuel, Garrett	1	12, 9-34		Rig
Refugio	Tweedy, A. E., Penn.	1	34, 5-31	1700	Idle
Summerland	Gauthier Oil Co.	17–1	22, 4-26	1400	Idle
San Luis Obispo County					
Edna	Loma Grande Oil Co., Lewis	1	28, 31-13		Rigging up
Elk Horn	Calif. Prod. Co.	1	6, 10-24	1550	Idle
	Western Plains Oil Corp.	1	7, 31-21	4010	Redrilling
Paso Robles	Ajax Land & Dev. Co., Moss	1	27, 26-13	475	Idle
	Vanguard Oil Co.	1	14, 27-14	4360	Idle
Ventura County					
Camarillo	So. Calif. Drlg. Co., Daly	2	26, 2-21	3090	Idle
Oxnard	Walter G. Rowe Johnson	1	15, 1-22	4500	Drilling
Ojai	High Mesa Oil Co.	1	16, 4-22	1525	Drilling
Red Mountain	Martin, J. W.	3	15, 4-21	1425	Drilling
Sespe	Commander Oil Co., Temescal	7-F	13, 4-18	215	Idle
	Condor	1	6, 4-19	2195	Idle
	Continental Oil Co., Elkins	1	23, 4-19	4150	Drilling
	Garmack Oil Co.	1	28, 5-19	565	Idle
	Crosby	1	15, 4-19		Grade
	La Salle & Van Dissen	1	15, 5-19		Grade
	Merchants Pet., Cochran	8	1, 4-20	525	Drilling
	Speik Oil Co.	1	33, 5-19	3440	Idle
	Terry, Geo., et al	1	23, 5-20	1340	Idle
	Williamson Oil Co.	1	1, 4-20	540	Idle
Simi	Trucano, Germanina	1	5, 2-17	1007	Idle
South Mt.	The Texas Co., Richardson	5	13, 3-21	4750	Drilling
	Clipper Oil Co., Scheiferle	1	17, 3-20		Rig
Tar Creek	Section 20 Oil Co.	1	20, 5-19	1580	Cleaning out
Timber Canyon	Stallings, Senter, Ahlberg	1	24, 4-21	675	Idle

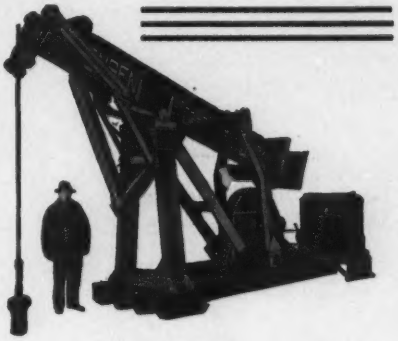
State Drilling Report

Field	Company	Well	No.	Sec.	Twp.	Range
NEW WELLS						
Wilmington	The Hancock Oil Co.	Harbor A-21, A-22 & A-23	3	58		13W
	Hogan Petroleum Co.	Graham	4	2	58	13W
	The Hancock Oil Co.	Harbor C-24	2	2	58	13W
Montebello	Standard Oil Co.	Harvey	3	2	2S	12W
	The St. Helens Pet. Co., Ltd	Eggleston	2	2	2S	12W
	West Montebello Oil Co.	Montebello	1	2	2S	12W
Torrance	Elexico Oil Corp.	Allen-K	1	23	4S	14W
	Walter Hughes	Hughes	2	23	4S	14W
	The Texas Co.	Wilson Comm.	10	22	4S	14W
	The Texas Co.	Wilson Comm.	11	14	4S	14W
Ventura	Tidewater Assoc. Oil Co.	V. L. & W.	39	14	3N	23W
	Tidewater Assoc. Oil. Co.	Lloyd	75	26	3N	23W
	Shell Oil Co.	Taylor	95	29	3N	23W
	Tidewater Assoc. Oil Co.	Hartman	7	22	3N	23W
Rincon	C. C. M. O. Co.	Hobson	B-21		3N	24W
	Richfield Oil Copr.	Hobson-State	F-5	17	3N	24W
	Richfield Oil Corp.	Hobson-State	F-6	8	3N	24W
Ventura	General Petroleum Corp.	Barnard	18	21	3N	23W
Lompoc	J. E. O'Donnell	Helen	1	8	7N	33W
Santa Maria	Douglas-Stratton Oil Co.	Douglas-Stratton	1	8	8N	33W
Santa Maria Valley	Union Oil Co.	Frank Vicente	3	21	10N	34W
	Pacific Western Oil Corp.	Carranza	2	28	10N	34W
	Union Oil Co.	Mallory	1	27	10N	34W
	Union Oil Co.	Nicolai	1	28	10N	34W
Kern River	The Hast Oil Co.	Kern	1	24	29S	28E
Fruitvale	Western Gulf Oil Co.	35-KCL-B		14	29S	27E
Midway	National Oil Co.		18	35	32S	23E
Kern Co.	Frank E. Abbott		1	18	27S	19E
	The Ohio Oil Co.	Tejon Ranch	D-3	28	11N	18W
Canal	Shell Oil Co.	Canal KCL-A	32-13	13	30S	25E
Mt. Poso	Coronado Oil Co.	Coronado	1	26	26S	28E
	Ring Oil Co., Ltd.	Louden	3	32	26S	28E
Rio Bravo	George F. Getty, Inc.	Ramsey	B-2	35	28S	25E
	The Superior Oil Co.	Helbling	1	1	29S	25E
Kern River	Oils Incorporated of Calif.	Seven Spot	4	13	28S	27E
Rio Vista Gas	Amerada Petroleum Corp.	Sacramento & San Joaquin Drainage Dist.	2	18	4N	3E
Huntington Beach	The Texas Co.	Pearce	3	2	6S	11W
Long Beach	Exeter Oil Co., Ltd.	Clark	2-A	24	4S	13W
	Winrock Oil Co.	Encinas	1	13	4S	13W
	Hilldon Oil Co.	Pool	3	13	4S	13W
El Segundo	Apex Petroleum Corp., Ltd.	Elsie	3	12	3S	15W
	Sovereign Oil Corp.	Community	2	12	3S	15W
Orange Co.	Shell Oil Co.	Weisel	1	16	4S	10W
Rosecrans	Union Oil Co.	Rosecrans	20	18	3S	13W
McKittrick	Leyse, Sonne & Dunham, Trustees	Pasadena	1	28	30S	22E
	Franco Western Oil Co.		15	8	30S	22E
Coalinga	Shell Oil Co.	Diamond	1	35	20S	14E
Tulare Co.	Baringer, Corbridge & Gould	Sears	2	29	24S	28E
DEEPEN OR REDRILL						
Torrance	C. C. M. O. Co.	Torrance	8	15	4S	14W
	Star Petroleum Co.	G & A	1	23	4S	14W
	Grubbs and Main	Lyman	1	22	4S	14W
	Kameo, Inc.		1	31	3S	13W
	C. C. M. O. Co.	Torrance	13	15	4S	14W
	MacDonald and Burns	Moore	8	22	4S	14W
	MacDonald and Burns	Moore	5	23	4S	14W
	Patton & Conway	Jean	1	23	4S	14W
Domingues	W. W. Stabler	Domingues	2	3	4S	13W
	Union Oil Co.	Callender	50	33	3S	13W
Long Beach	Allied Petroleum Corp.	Allied	12	19	4S	12W
	Doyle-Clune Oil Co.	Doyle & Clune	1	29	4S	12W
Huntington Beach	Standard Oil Co.	Huntington B	64	10	6S	11W
Santa Fe Springs	The Texas Co.	Foix	1	6	3S	11W
	Standard Oil Co.	Walker Comm.	17	6	3S	11W
	Bandini Petroleum Co.	Off	14	5	3S	11W
	General Petroleum Corp.	Santa Fe 168-B, 168-E, 205 & 208		5	3S	11W
	J. A. Smith	Italo-Brunson	1	6	3S	11W
Elwood	Bankline Oil Co.		89-7	15	4N	29W
Lost Hills	Tidewater Assoc. Oil Co.	Williamson	10-B	11	26S	20E
Beiridge	Beiridge Oil Co.		17-35	35	27S	20E
Midway	North American Oil Cons.		6	2	32S	23E
Edison	A. T. Jergins Trust	Wright-Bloemer	1	30	30S	29E
Fruitvale	Calif. Western Oil Co., Ltd.	K. C. L.	1	14	29S	27E
	Mohawk Petroleum Corp.		4	27	29S	27E
El Segundo	Gov't Ref. & Gaso. Corp., Ltd.	Ramsey-Wallace	1	12	3S	15W
	Richfield Oil Corp.	Elsie	1	12	3S	15W
Wilmington	George F. Getty, Inc.	W-1	33	4S	13W	
	Pacific Western Oil Corp.	Ronan Comm.	1	33	4S	13W
	Bankline Oil Co.	Pacific Term. Comm.	1	33	4S	13W
Rincon	Rincon Oil Co.	Shudde	3	7	3N	24W
Ventura	Tidewater Assoc. Oil Co.	Lloyd	111	27	3N	23W
Capitan	Shell Oil Co.	Covarrubias 2	2	32	5N	30W
Mountain View	Mohawk Petroleum Corp.	Clendenen	7 & 9	30	30S	29E
	Canal Oil Co.	Bloemer	1	30	30S	29E
Mt. Poso	The Texas Co.	Gilde 2	1 & 3	15	27S	28E
Kern Co.	Dilamar Oil Corp.	Quinn	1	15	25S	27E
Midway	Lilly Oil Co.	Lilly	2	36	32S	23E
Kettleman North	Standard Oil Co.		38	19	21S	17E
ABANDON						
Long Beach	Exeter Oil Co., Ltd.	Clark	2-A	24	4S	13W
	Shell Oil Co.	Cherry Hill Comm.	5	30	4S	12W
Whittier	Fullerton Oil Co.		5	25	2S	11W
Montebello	The St. Helens Pet. Co., Ltd.	Monterey	3	2	2S	12W
Los Angeles Co.	Vanco Development Co., Ltd.	Millard	1	25	3S	12W
Santa Maria Valley	Valoco Oil Co., Ltd.	Valoco	1	28	10N	33W
Santa Fe Springs	Scotch Oil Co., Ltd.	Scotch Oil Co.	1	6	3S	11W
Torrance	White Five Oil Co.		1	21	3S	14W
Wilmington	Pioneer Petrol Corp.		1	26	4S	13W
San Luis Obispo Co.	Burkholder Oil Corp.	Clay	1	14	10N	26W
Midway	The Texas Co.	Thornber	B-4	34	31S	24E
	The Texas Co.		12	16	32S	24E
	The Texas Co.	Thornber	1	34	31S	24E
Beiridge	The Ohio Oil Co.	Ford Permit	1	6	29S	22E
Kern Co.	Bacal Oil Co.	Bacal	1	5	30S	30E
Mt. Poso	Seaboard Oil Co.	Glide	1	7	27S	28E
	Coronado Oil Co.	Coronado	1	28	26S	28E
Coalinga	Shell Oil Co.	Section One	1	35	20S	14E
	Shell Oil Co.	Diamond	1	35	20S	14E

Summary	Week Ending May 14	Previous Week	To Date This Year	To Date Last Year
Total New Wells	20	30	452	557
Total Deepened or Redrilled	17	27	324	259
Total Abandoned	12	7	181	180

Stabler to Redrill Old Dominguez No. 2

Following the successful completion of Selbar Oil Co., United No. 1 at Dominquez last winter, W. W. Stabler entered the field and is now preparing to redrill the old Marland Oil Co. Dominquez No. 2. By carefully controlled drilling, Mr. Stabler believes this well may be bottomed near the north property line and completed in the 4200 ft. sand with production equalling that of its 200 bbl. easterly offset, Selbar No. 1.



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South Mountain Test Drilling Below 4750 Ft.

The Texas Co. is continuing in its slow and careful course of development in its deep test of the South Mountain field. Yale Richardson No. 5, located in sec. 13, 3-21, and now below 4750 ft., has made no production tests to date though showings have been sufficient to warrant running a formation tester.

Santa Barbara Test At 2100 in Sec. 8, 8-33

The Douglass-Stratton Oil Co., headed by Donald Douglas of the aircraft firm bearing his name, has spudded its new test of the Carreaga area of Santa Barbara County. Located in sec. 8, 8-33, the well is drilling in hard shale formations at 2100 ft.

Name Distributor for Wire Rope Equipment

Announcement has just been made by George B. Gemmill, vice president of Wire Rope Equipment Manufacturing Co. of Seattle, Wash., manufacturers of the well-known Double Blue Lines Wire Rope of the appointment of the Hopper Machine Works, Inc., of Bakersfield, Calif., as distributors for their products.

The Southern California distributors for Wire Rope Equipment & Manufacturing Co. in addition to the Hopper Machine Works, Inc. at Bakersfield include The California Wire Cloth Corp. of Los Angeles.

Pneumatic Remote Control

A remote automatic control system, combining two standard lines of Bristol's instruments, has been developed by Engineers of the Bristol Co., Waterbury, Conn. It consists of the Metameter system of telemetering and the Free-Vane principle of pneumatic control.

An installation now using these instruments for automatic control of pressure in a gas distribution system is described in Bulletin No. 506. The system consists of two instruments, a pressure transmitter and a pressure recorder controller, located 1½ miles apart. These instruments automatically maintain the gas distribution pressure at a uniform value, regardless of peak-load demand. Being automatic they take care of all conditions of load change, even the abrupt ones, that occur without advance warning. A copy of Bulletin No. 506 may be obtained upon request.

East Puente Hills To Be Well Tested

To continue the search for commercial oil in the East Puente Hills, near Chino in San Bernardino county, George Marcell has organized the Carbon Canyon Oil Co. Preliminary operations have already been started for the first test well which will be located on the John Schuch property in sec. 31,2-8. Mr. Marcell's first venture in the area, several years ago, obtained sufficient showings to warrant further exploration, according to geologist George Atha, on whose recommendation the new well is being drilled.

Plan New Wildcat In San Luis Obispo

Indicating that San Luis Obispo county is soon to have another test, the Page Oil Co., recently formed in Long Beach by San Francisco capital, is reported to have acquired large blocks of acreage near the coast. Plans of the new concern have not yet been released but rumor has it that operations will be started in the early summer.

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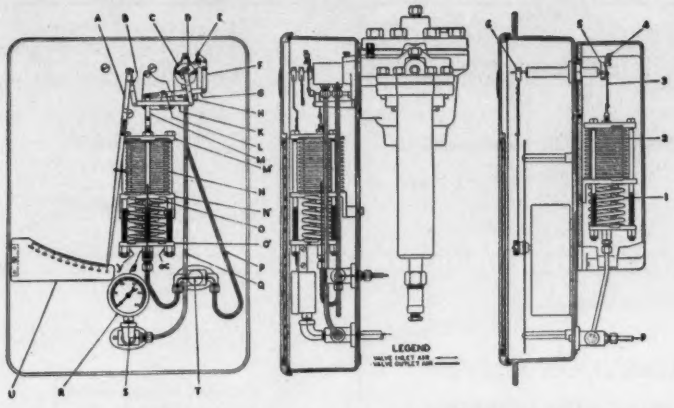
American Meter Exhibits Air Type Remote Recorder



Sending Unit of METRIC Air-Actuated Remote Recorder.

Receiving Unit of METRIC Air-Actuated Remote Recorder.

The engineers of Metric Metal Works, Erie, Pa., of American Meter Co., announce the completion of field installation tests on their perfected new "Metric" Air-Actuated Remote Recorder. A model exhibited at the International Petroleum Exposition, May 14-21, by the Westcott & Greis, Inc., Division of American Meter Co.

Now formally listed among Metric-American products, this Remote Recorder accurately charts—at a point remote from meter installation—the volume of gas, air, steam or fluid measured by orifice method. The device consists of sending, receiving and control apparatus — and the control mechanism may be installed in either the sending or receiving unit case.

(This same principle of remote transmission may be utilized in connection with zero to 100% throttling—in the control of rate-volume, or for automatic reset control.)

Position of differential pen arm in the sending unit of the Remote Recorder is at all times duplicated in the receiving unit by the position of the differential pen arm which makes the chart record, and there is little lag in synchronization. Sending and receiving units are connected by 3/16-inch copper tubing. To put the Remote Recorder into service, it is necessary only to set the differential pen arm at zero on the chart, and to open air line valve and adjust a pressure reducing valve. Operation is positive. It may be described as follows, and a complete description of detail is available on request.

Valve in the air line, connected at S, is opened; and pressure reducing valve in the sending instrument is adjusted so that 35 pounds is shown on gage R. Differential pen arm 6 in the receiving instrument will leave the chart hub and come to rest at zero (if necessary, adjust to zero with micrometer on pen arm.)

A forged steel Westcott Orifice Meter differential gage in the sending instrument actuates differential pen arm A and lever B. Pen arm A indicates on Scale U the differential across the orifice plate at each instant. Lever B, through link K and lever H, moves the valve of a standard Metric Rotary Pilot (C)—consisting essentially of housing sleeve, rotary seat and rotary valve. Air supply for pilot valve C is connected at S. Gage R, indicating pressure available, is connected to pilot valve C by line Q. The outlet of pilot valve C is line P, which is connected to syphon N, and at point T is connected to the receiving instrument.

If differential pen arm A is moved in a clockwise direction, lever H moves the valve of pilot C, increasing pressure in outlet pine P. Line P extends through spring O and is connected to sylphon N at bracket N'. Pressure increases in line P causes spring loaded sylphon N to expand, M' and O' to rise, and spring O then to be compressed. Link M moves lever G (pivoted at L) clockwise, and this movement through link F, adjustment E and lever D, moves clockwise the seat of the pilot.

It is seen that the valve of the Petric Pilot is moved by the differential pen arm, and the seat of the pilot valve is moved in the same direction by the expansion of sylphon N. Consequently, when the seat of the pilot valve moves through the same angle as the valve, there will be no further increase in pressure in line P. For a definite movement of the pen arm, there will be a definite expansion of the sylphon N to permit a definite pressure in line P, and to produce definite compression in spring O. Therefore, a definite pressure in the outlet line P will be obtained for each position of differential arm A.

The force available for moving the pilot valve seat and compressing the spring for a full scale deflection, is 30 pounds. Since practically all of this pressure is utilized in compressing the spring, a small change in friction will not produce any inaccuracy.

Outlet line P is connected to the receiving instrument, which consists of a spring loaded sylphon 1-2 (exactly similar to sylphon N-O). Sylphon 1-2—through link 3, adjustment 4 and lever 5—actuates pen arm 6. As there is definite position of slyphon 1-2 for each pressure in line P, just as there is for sylphon N-O, pen arm 6 will assume a definite position on the chart for each definite position of pen arm A in the sending instrument—and the positions of these two pen arms always will be the same. As in the sending instrument, 30 pounds is available for spring compression and movement of the control mechanism for a full scale deflection.

Accuracy of this long distance transmitter has been verified during an extended period of rigorous test in various field installations.

New Brushable Corrosion Resistant

To further complete their line of corrosion-resistant coatings, the American Concrete & Steel Pipe Co., 4635 Firestone Blvd., South Gate, (Los Angeles County) Calif., announces the perfection of Amercoat Rapid-Dry Coating.

Amercoat Rapid-Dry Coating differs from Amercoat Enamel and Amercoat Plastic in that it is not particularly designed to resist erosion and abrasion as well as corrosion. It is a quick-drying solution which may be applied with a paint brush or with paint spray equipment to form a protective covering for exterior and a lining for interior surfaces that are subjected to the corrosive action of liquids, gases, or solids.

This Amercoat Rapid-Dry Coating is supplied ready-mixed for immediate application over Amercoat Concrete Prime or Amercoat Metal and Wood Prime, and its coverage is from 200 to 250 square feet per gallon.

For ordinary protection against corrosive fumes, weathering, etc. ,a single coat of Amercoat Rapid-Rry Coating Solution over the proper Amercoat Prime will be ample protection, but a second or third coat will increase the corrosion resistance where conditions make two or more coats necessary.

Amercoat Rapid-Dry Coating will resist the action of acid and alkali and other types of corrosive agents up to and including 20% concentration. It is insoluble in salt water or in the petroleum derivatives.

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WILDCAT MAP

New colored map of entire San Joaquin Valley, $7.50. Shows all oil and gas fields and prospect wells, with status on March 10, 1938. Earl M. Price & Co., Bakersfield, Calif. 5-20-d

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MAPS

Newly-revised map of 140,000 acres from Shafter to Gosford, in Kern Co., Calif., including Rio Bravo, Greeley, Ten-Section, Canal & Canfield Ranch Oilfields. Shows owners, leases, wells. One inch to 2,000 ft., $4.85 plus 15c tax. Similar map Wasco, Shafter, Rio Bravo & area around deep Continental well, same price. Both maps $8.74 plus 26c tax, prepaid.
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Oil Men's Calendar

May

14-21—Tulsa. International Petroleum Exposition.

May 23-25—8th Mid-Year Meeting, American Petroleum Institute, Allis & Lassen Hotels, Wichita, Kans.

June

California Natural Gasoline Assn. meets the first Thursday of each month.

4—San Joaquin Oil Men Annual Barbecue and Golf Tournament—Bakersfield.

6—Houston, Tex. Oil Workers International Union.

11—C.N.G.A. Frolic, Girard Country Club, Los Angeles.

20-24—St. Louis, Mo. American Society of Mechanical Engineers.

September

5-9—American Chemical Society, Milwaukee, Wis.

14-16—Santa Barbara, Calif., annual meeting Pacific Coast Gas Association, Biltmore Hotel.

14-16—National Petroleum Assn., 36th Annual Meeting Hotel Traymore, Atlantic City, N. J.

21-23—National Industrial Advertisers Assn., Inc., 16th Annual Meeting, Cleveland, Ohio.

23-25—A. P. I., Mid - Year Meeting, Wichita, Kansas.

MAPS
Large map of Los Angeles Basin oil fields and map showing all California oil fields. Price $15.00 each on paper and $20 each on cloth. Individual state oil and gas maps of Mid-Continent and Rocky Mountain regions. Maps show geological cross sections at base. These maps indicate wells drilling, wells producing and abandoned, with depths.
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